Atty. Docket # AUS920010381US1
Benfield et al.
Method and system for presentation and specification of distributed multi-customer
configuration management within a network management framework

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FIG. 1

(PRIOR ART)

FIG. 2A

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Benfield et al.
Method and system for presentation and specification of distributed multi-customer
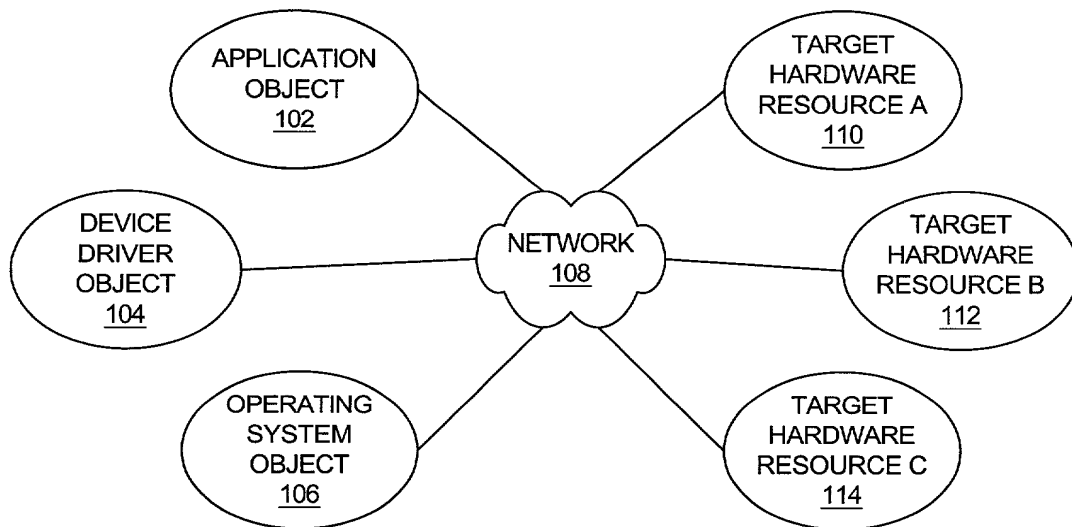**configuration management within a network management framework**

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FIG. 2B

FIG. 2C

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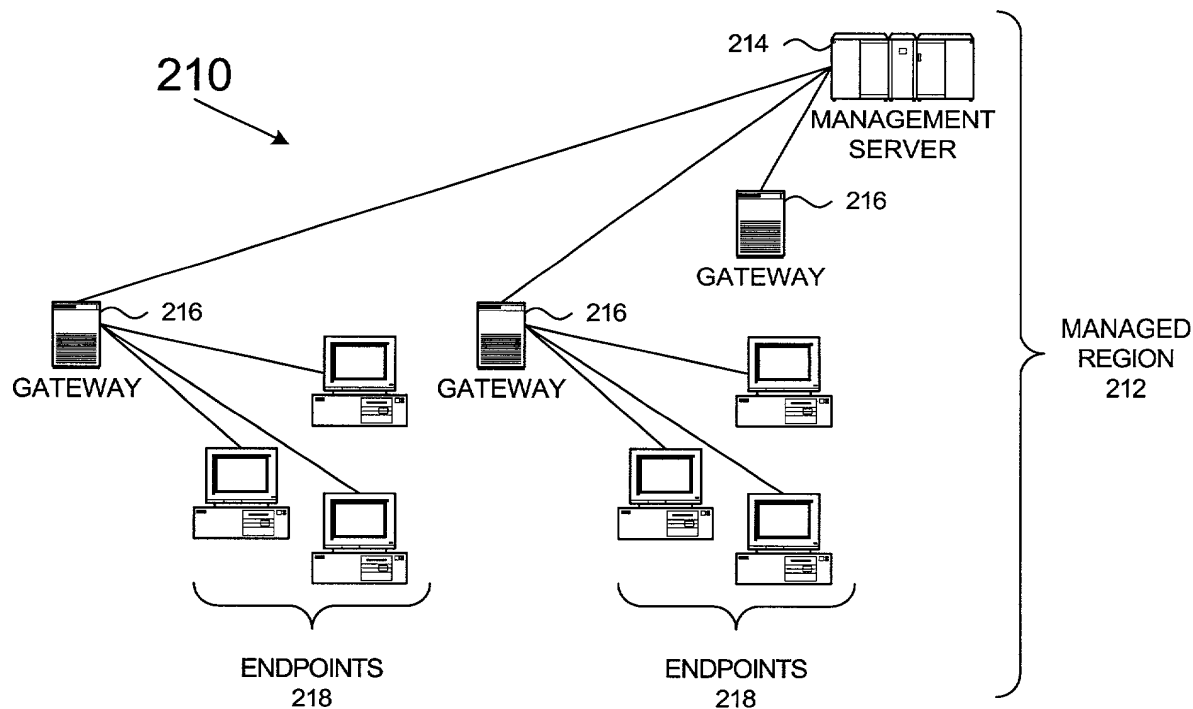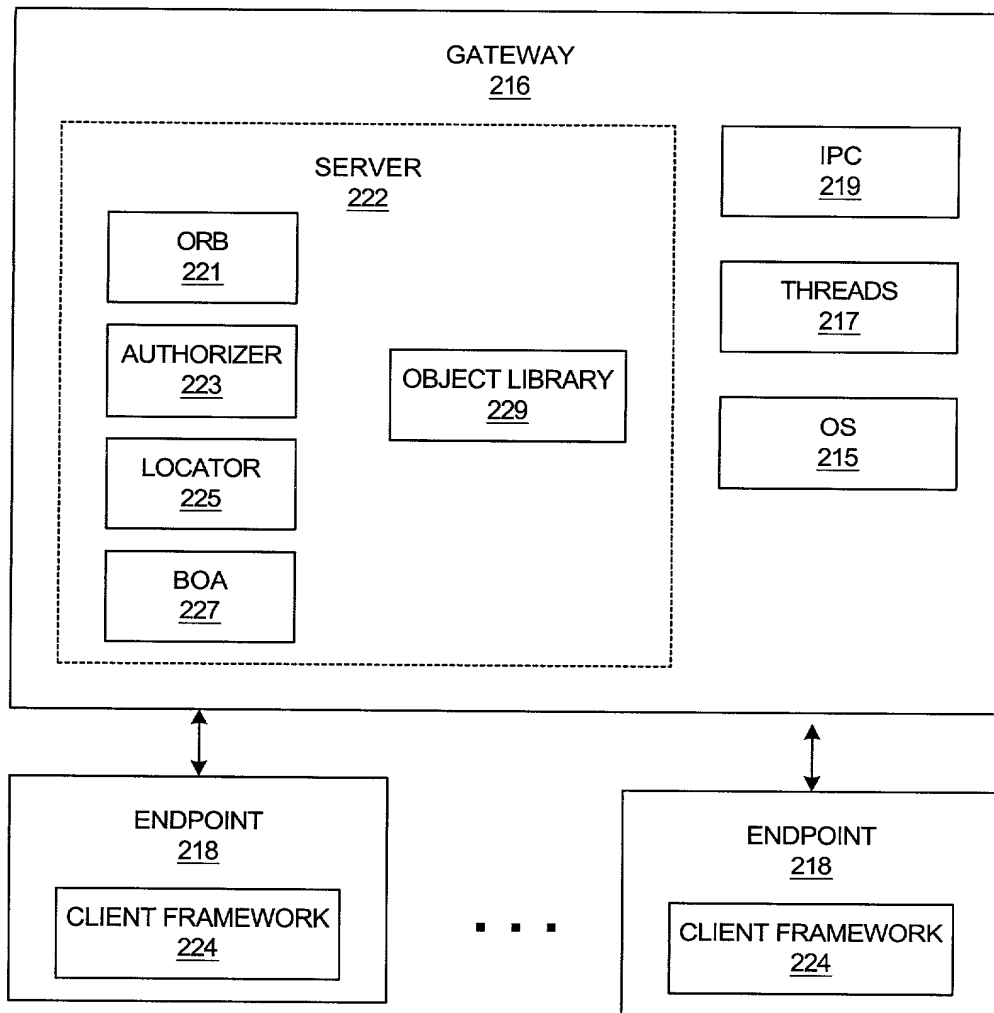configuration management within a network management framework

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BRANCH OFFICE
238

CENTRAL OFFICE
240

BRANCH OFFICE
239

ENDPOINT A
230

APPLICATION ACTION OBJECT
232

OPERATING
SYSTEM
OBJECT
236

DEVICE
DRIVER
OBJECT
234

ENDPOINT B
231

APPLICATION OBJECT
233

OPERATING
SYSTEM
OBJECT
237

DEVICE
DRIVER
OBJECT
235

FIG. 2D

ENDPOINT A
252

APPLICATION STACK
254

DISTRIBUTED KERNEL
SERVICES/JVM
255

OPERATING SYSTEM
RESOURCES
256

NETWORK
DEVICE DRIVERS
257

NIC
258

FIG. 2E

ENDPOINT B
253

APPLICATION STACK
254

DISTRIBUTED KERNEL
SERVICES/JVM
255

OPERATING SYSTEM
RESOURCES
256

NETWORK
DEVICE DRIVERS
257

NIC
258

NETWORK
250

DISTRIBUTED KERNEL SERVICES (DKS) GATEWAY
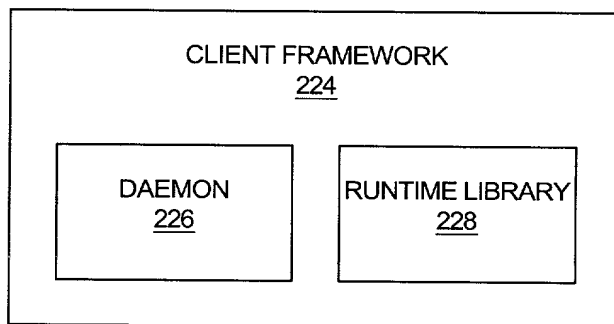251

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FIG. 2F

FIG. 2G

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ENDPOINT A 301	GATEWAY 300	ENDPOINT B 302
DKS ORB (ENDPOINT A) 320	ORB (DKS SERVICES) 304	DKS ORB (ENDPOINT B) 322
DKS APPLICATION (RESOURCE REQUESTER) 324	NETWORK ENDPOINT LOCATION (NELS) SERVICE 306	TARGET RESOURCE (RESOURCE PROVIDER, OBJECT, OR APP) 326
DKS SERVICES-- ENDPOINT 330	IP OBJECT PERSISTENCE (IPOP) SERVICE 308	DKS SERVICES-- ENDPOINT 334
	GATEWAY SERVICES 310	

FIG. 3

IP OBJECT PERSISTENCE (IPOP) SERVICE DATABASE 402	ENDPOINT DB TABLE 404	SYSTEM DB TABLE 406	NETWORK DB TABLE 408
	TOPO OBJECT	TOPO OBJECT	TOPO OBJECT
	⋮	⋮	⋮
	TOPO OBJECT	TOPO OBJECT	TOPO OBJECT

FIG. 4

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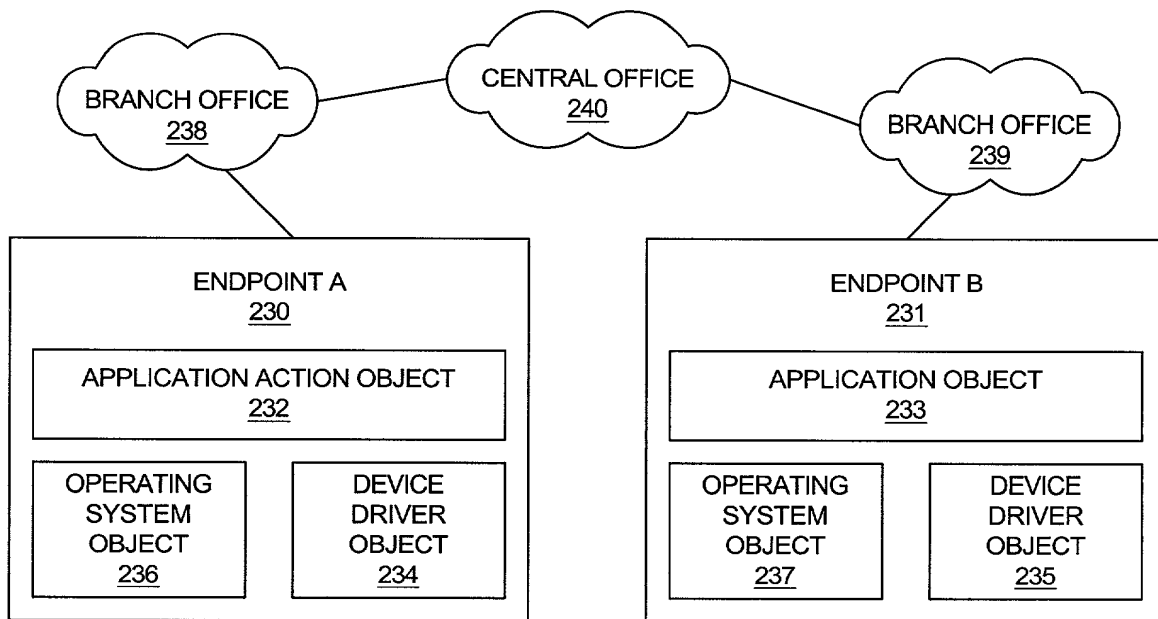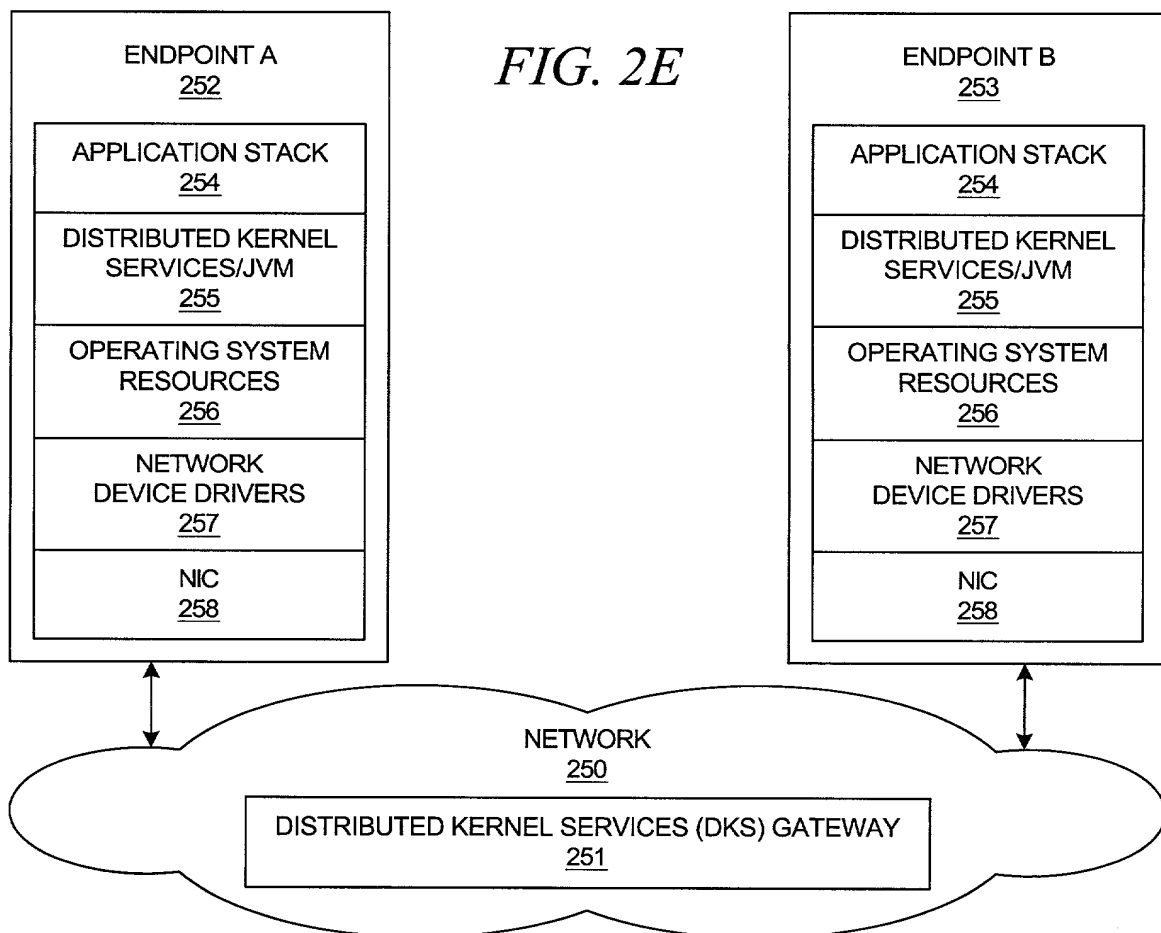configuration management within a network management framework

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500

PHYSICAL IP NETWORKS
514

IP DRIVER
502

MONITOR
CONTROLLER
516

DISCOVERY
CONTROLLER
506

NETWORK
EVENT
MANAGER
APPLICATION
522

CONFIGURATION
SERVICE
528

IP DRIVER
CONTROLLER
530

IP DATA
CACHE
520

APPLICATION/
USERS
524

IP DRIVER
INTERFACE
526

IP MAPPER
508

TOPOLOGY
SERVICE
504

IP
DATASTORE
518

IP OBJECT
PERSISTENCE
(IPOP)
SERVICE
510

IPOP
DATABASE
512

FIG. 5A

DRIVER 1 SCOPE (D1)

1.2.11.22

1.2.11.0

ROUTER

DRIVER 2 SCOPE (D2)

1.2.12.0

1.2.12.22

1.2.13.22

1.2.14.22

1.2.13.0

1.2.14.0

FIG. 5B

DRIVER 3 SCOPE (D3)

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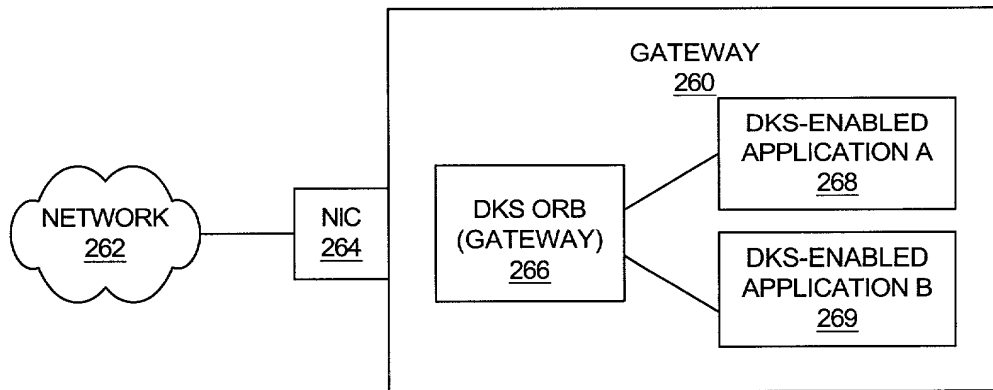configuration management within a network management framework

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FIG. 5C

FIG. 6

Atty. Docket # AUS920010381US1
Benfield et al.
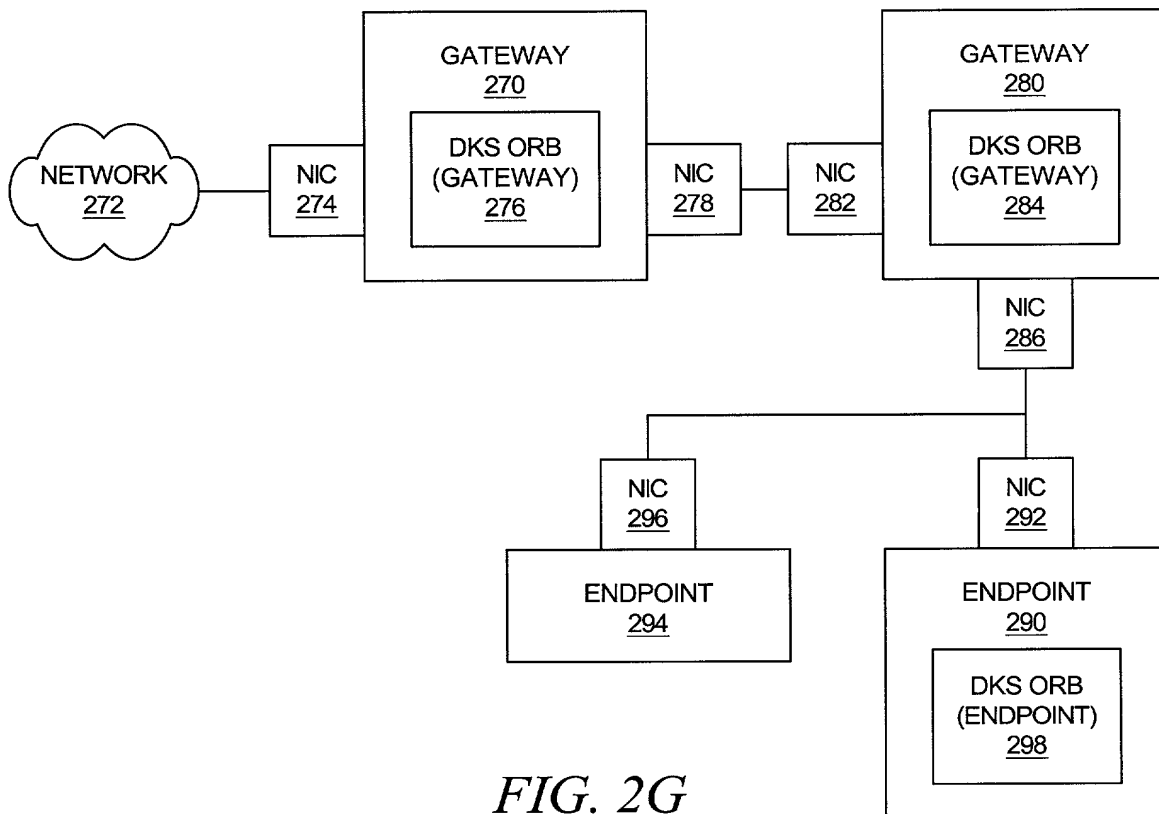Method and system for presentation and specification of distributed multi-customer
configuration management within a network management framework

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BEGIN

DISCOVERY ENGINE PERFORMS
DISCOVERY PROCESS ON
NETWORK AFTER
CONFIGURATION OF NETWORK
BY ADMINISTRATOR
702

DSC CREATOR
GENERATES DSC OBJECTS
704

SOURCE USER PERFORMS
LOGIN ON SOURCE EP
706

SECURITY SUBSYSTEM
UPDATES ACTIVE USER
DATABASE FOR ORB
708

END

FIG. 7A

BEGIN

FETCH ENDPOINT DATA FROM
IPOP
710

FETCH USER DATA FROM
ALL-USER DATABASE
IN SECURITY SUBSYSTEM
712

FETCH DSC CONFIGURATION
DATA FROM CONFIGURATION
SERVICE DATABASE
714

CREATE DSC OBJECTS
FOR ALL USERS
716

CREATE DSC OBJECTS
FOR ALL ENDPOINTS
718

END

FIG. 7B

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Method and system for presentation and specification of distributed multi-customer
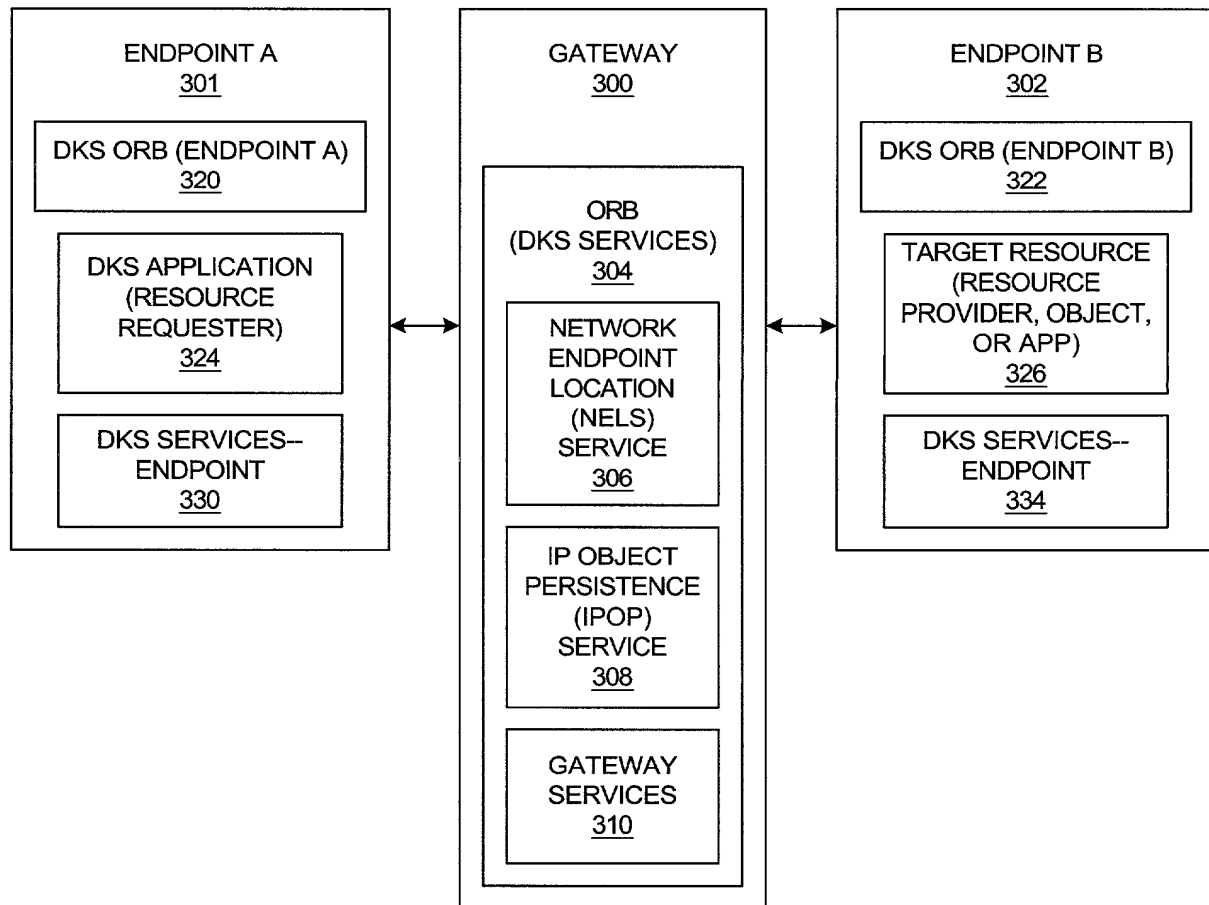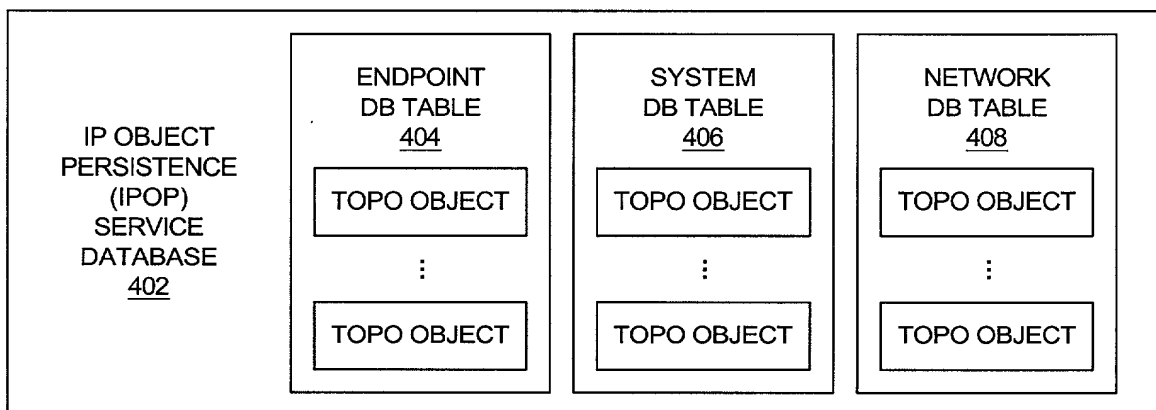**configuration management within a network management framework**

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FIG. 7C

BEGIN

↓

READ SCOPE DATA FOR
TARGET ENDPOINT FROM IPOP
720

↓

READ SCOPE DATA FOR
SOURCE USER
FROM IPOP
722

↓

IS
SOURCE
USER ALLOWED
ACCESS TO TARGET
ENDPOINT?
724 — NO

↓ YES

CREATE DSC FOR CURRENT
USER/ENDPOINT COMBINATION
726

↓

STORE CREATED DSC OBJECT
IN DSC DATABASE
728

↓

MORE
USERS TO PROCESS?
729 — YES

↓ NO

END

FIG. 7D

BEGIN

↓

READ SCOPE DATA FOR
TARGET ENDPOINT FROM IPOP
730

↓

READ SCOPE DATA FOR
SOURCE ENDPOINT
FROM IPOP
732

↓

DOES
SOURCE ENDPOINT
HAVE ACCESS TO TARGET
ENDPOINT?
734 — NO

↓ YES

CREATE DSC FOR SOURCE
ENDPOINT/TARGET ENDPOINT
COMBINATION
736

↓

STORE CREATED DSC OBJECT
IN DSC DATABASE
738

↓

MORE ENDPOINTS TO
PROCESS?
739 — YES

↓ NO

END

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Method and system for presentation and specification of distributed multi-customer
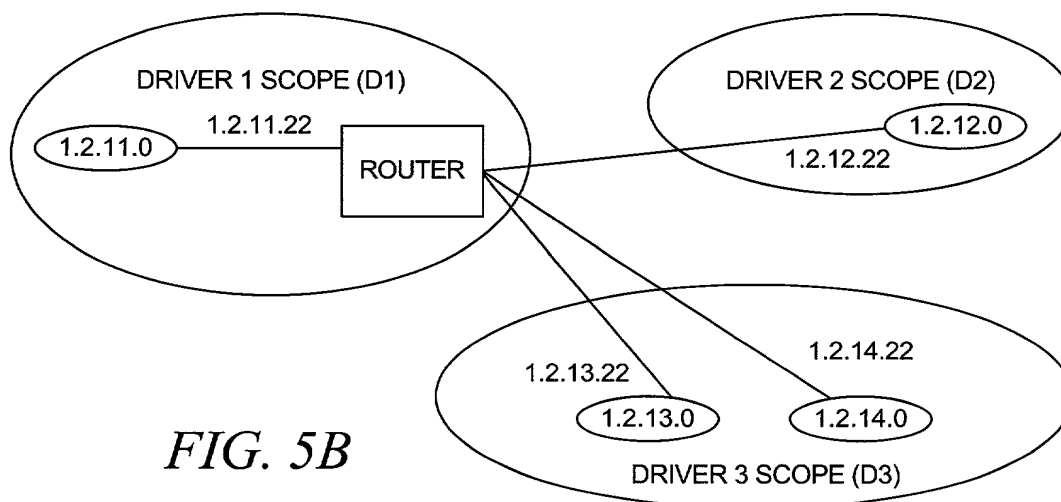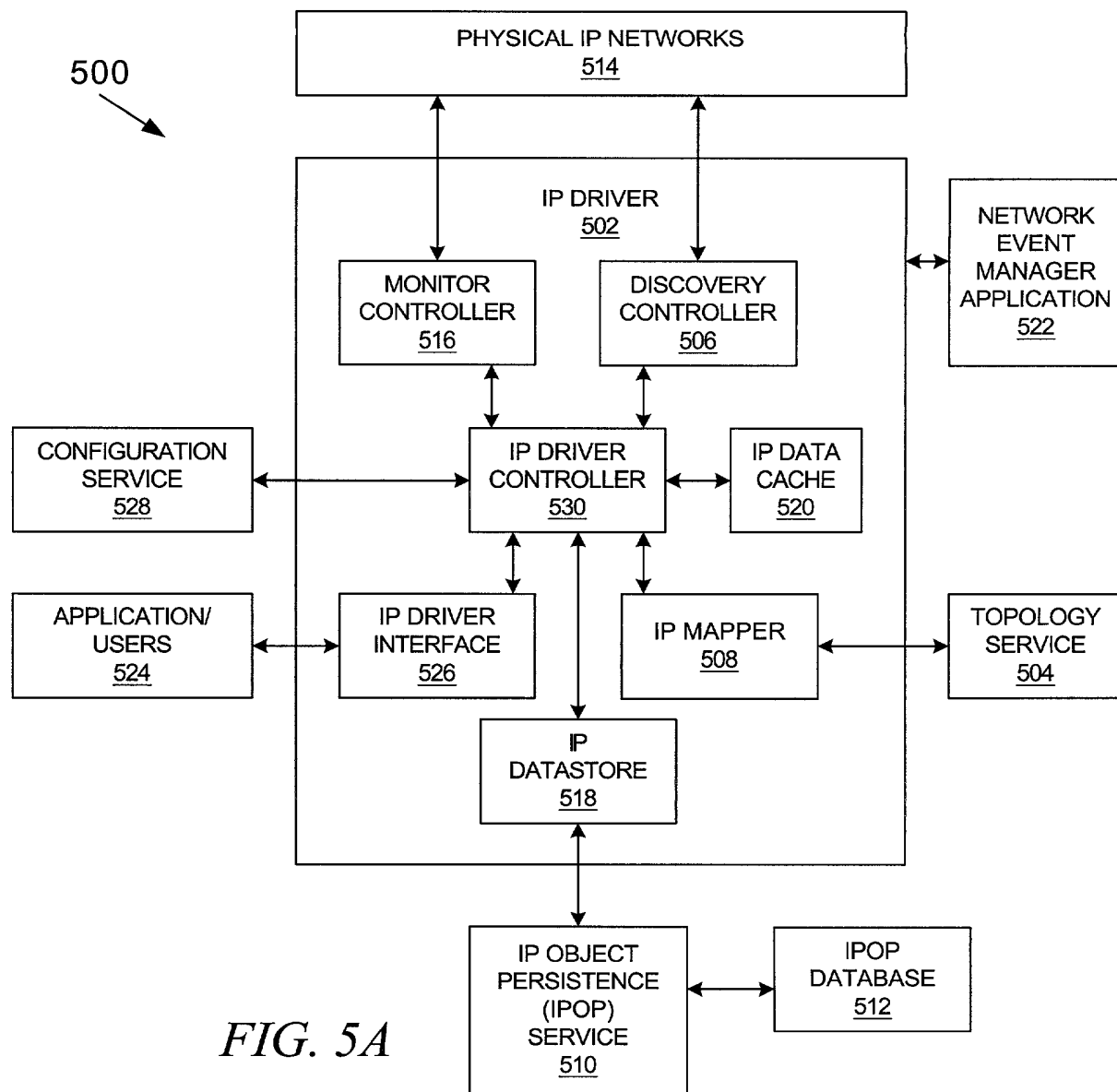configuration management within a network management framework

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BEGIN

DISCOVERY ENGINE SCANS PHYSICAL
NETWORK UNTIL NEW DEVICE IS FOUND
802

DOES NETWORK EXIST?
804

NO → CREATE PHYSICAL
NETWORK OBJECT
806

YES

DOES SYSTEM EXIST?
808

NO → CREATE PHYSICAL
SYSTEM OBJECT
810

YES

CREATE PHYSICAL ENDPOINT OBJECT FOR
DISCOVERED DEVICE
812

STORE CREATED OBJECTS INTO IPOP DB
814

MAP CREATED OBJECTS INTO TOPOLOGY
816

CREATE TOPOLOGY OBJECTS
818

STORE TOPOLOGY OBJECTS INTO
TOPOLOGY DATABASE
820

END

FIG. 8A

900

Topology Console Application   ☐ ☐ ☒

908   R1
902 ~ ROUTER1 ——— ENDPOINT1 ~ 904
910   R2 ——— ENDPOINT2 ~ 906
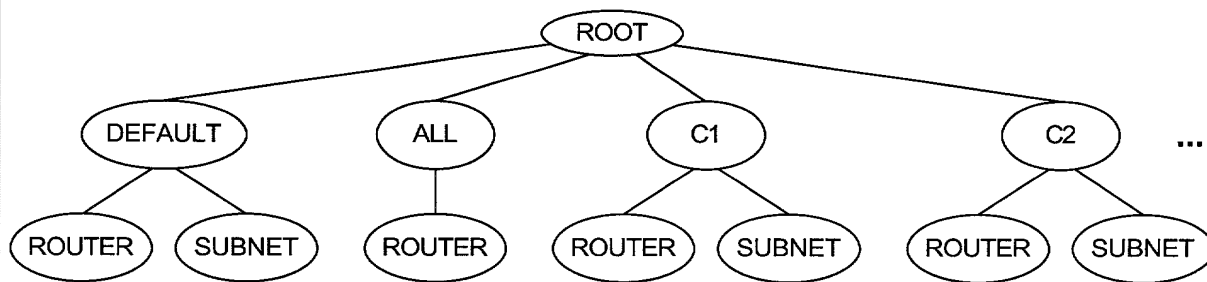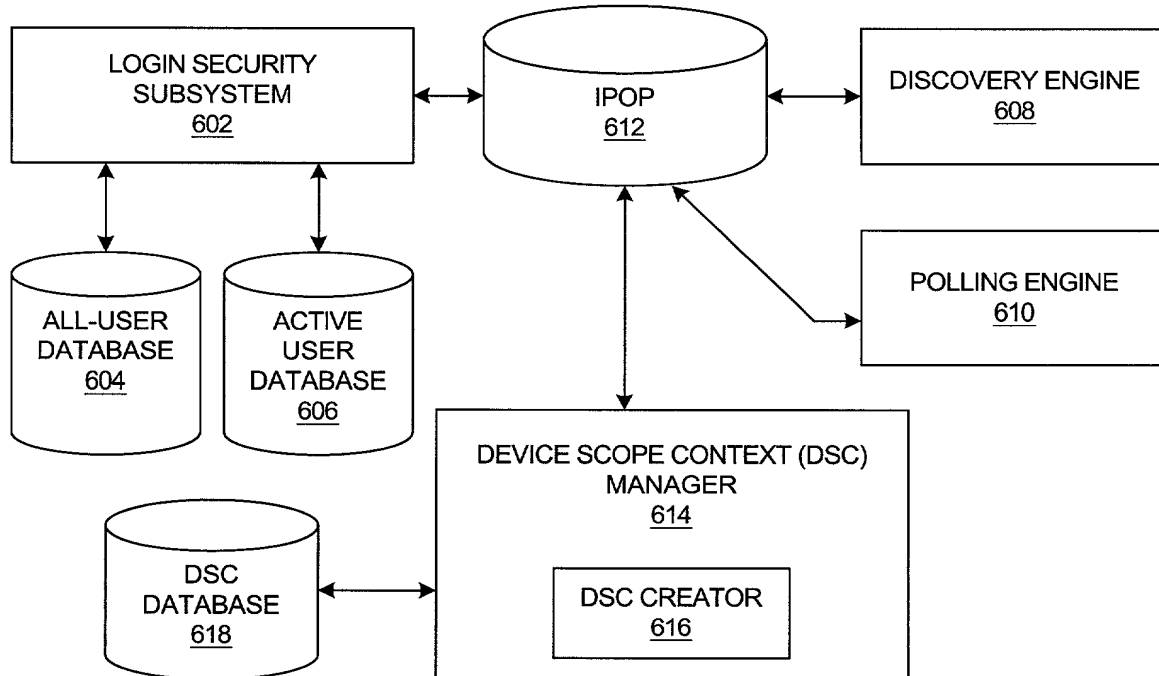
OK

FIG. 9A

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Method and system for presentation and specification of distributed multi-customer
configuration management within a network management framework

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BEGIN

FAILED
SYSTEM FOUND BY POLLING?
832

NO

NEW
DEVICE DISCOVERED?
834

NO

YES

YES

UPDATE IPOP DATABASE
836

DOES
CHANGE AFFECT TOPOLOGY?
838

NO

YES

UPDATE CURRENT TOPOLOGY DATABASE
840

END

FIG. 8B

930

Topology Console Application   □ ⊡ ☒

936

R1

ENDPOINT1   934

932   ROUTER1

OK

FIG. 9B

Atty. Docket # AUS920010381US1
Benfield et al.
Method and system for presentation and specification of distributed multi-customer
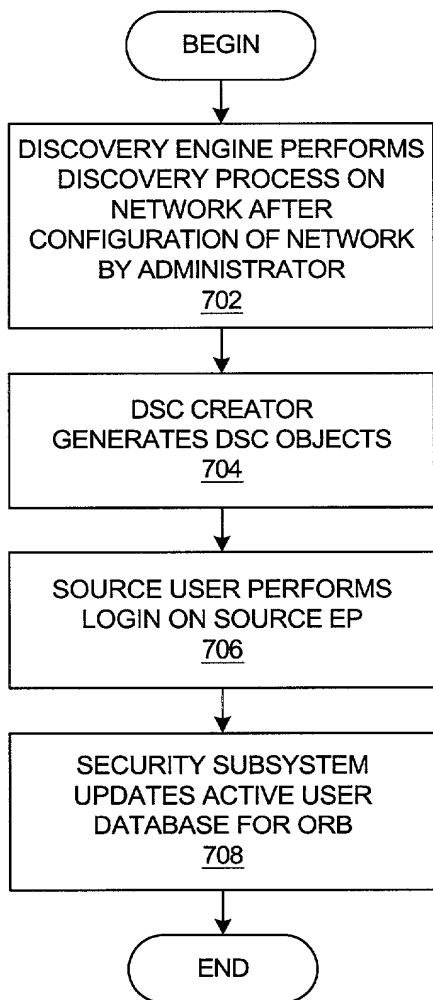configuration management within a network management framework

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EXTERNAL
NETWORK
1022

OUTER
NIC
1026

FIREWALL/NETWORK ADDRESS
TRANSLATOR (NAT)
1020

INNER
NIC
1028

SYSTEM A
1030

(10.0.0.1)

NIC
1032

INTERNAL PROTECTED
NETWORK
1024

NIC
1040

SYSTEM C
1038

(10.0.0.3)

NIC
1036

SYSTEM B
1034
(10.0.0.2)

FIG. 10A
(PRIOR ART)

SERVICE
PROVIDER
1050

MULTICUSTOMER DATABASE
1052

CUSTOMER A
1054

NAT
1058

SUBNET A
1056

CUSTOMER B
1064

NAT
1068

SUBNET Z
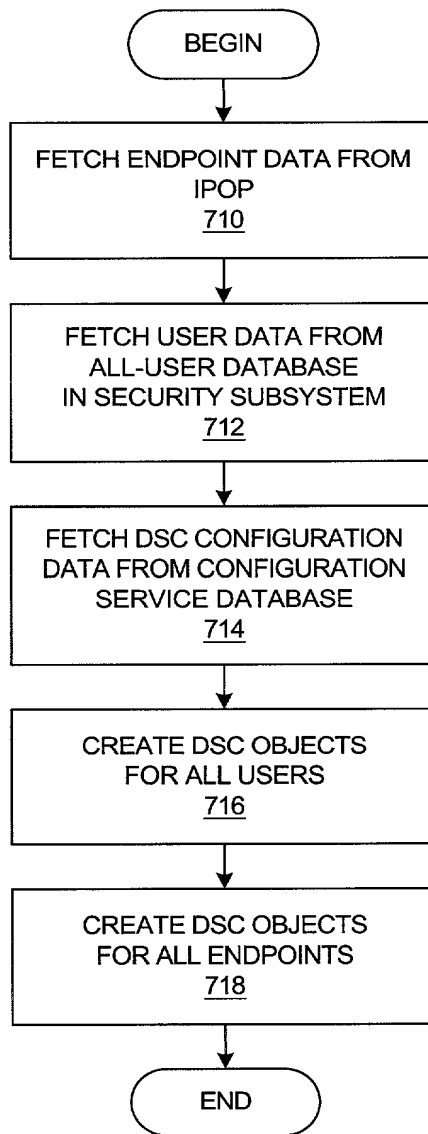1066

FIG. 10B

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Method and system for presentation and specification of distributed multi-customer
configuration management within a network management framework

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DKS CUSTOMER ADDRESS MANAGER SERVICE
1116

CUSTOMER LOGICAL NETWORK CREATOR
1118

VPN CREATOR
1120

ANCHORNAME
CREATOR
1122

CUSTOMER AND VPN ID CREATOR
1124

DKS ORB/CORE
SERVICES
1114

USER SECURITY
SUBSYSTEM
1106

IPOP
1112

IP DRIVER
1108

GATEWAY/NEL
1110

FIG. 11A

1350

Network Management Application

☐ ☐ ☒

NETWORKS REQUIRING VPN CREATION–DUPLICATE ADDRESSES EXIST

PHYSICAL NETWORK ADDRESS: 10.7.205.103   1352

CUSTOMER ANCHORNAME: AUSTIN\BLDG1   1356

VPN ID: 1370

PHYSICAL NETWORK ADDRESS: 10.7.205.103   1354

CUSTOMER ANCHORNAME: AUSTIN\BLDG2   1358

VPN ID: 1372

1378   ☒   CHANGE VPN ID
FOR ENTIRE SCOPE

SET   1374   1376   CLEAR

FIG. 13

Atty. Docket # AUS920010381US1
Benfield et al.
Method and system for presentation and specification of distributed multi-customer
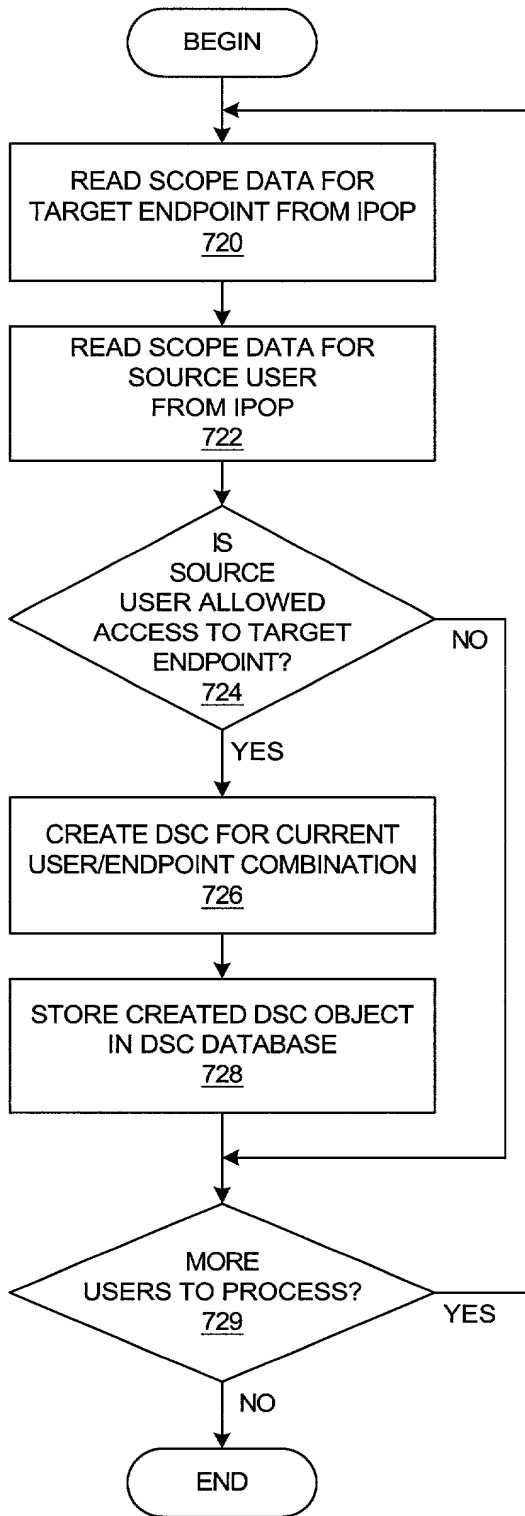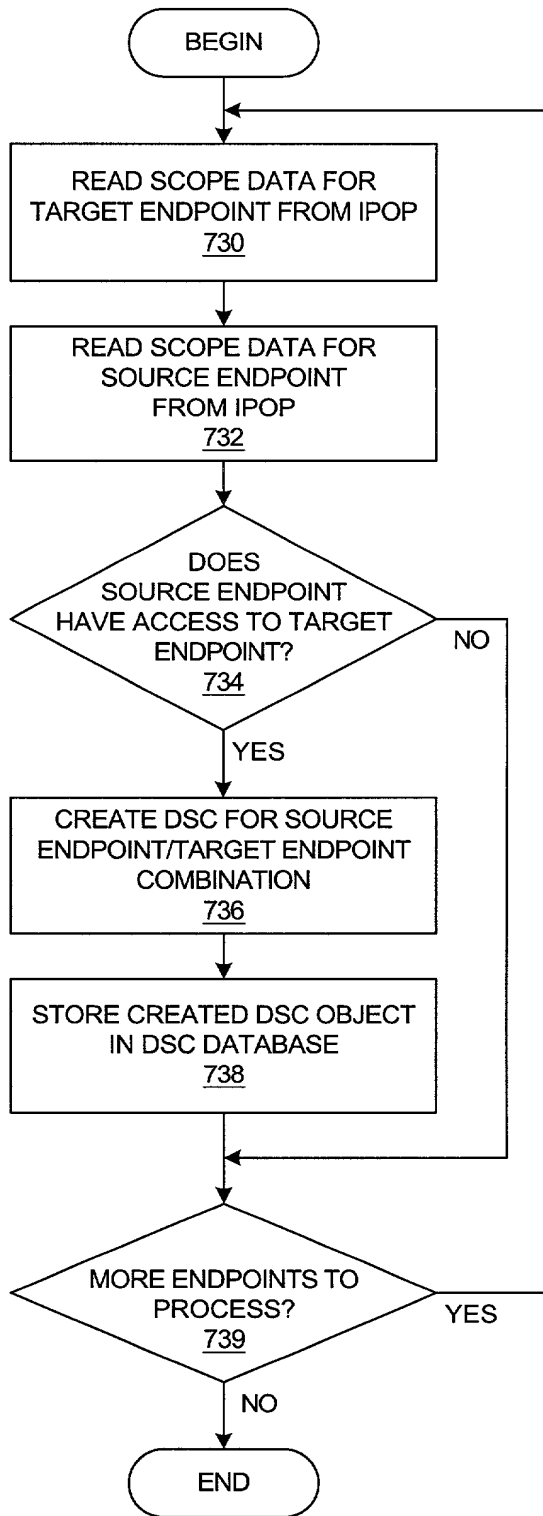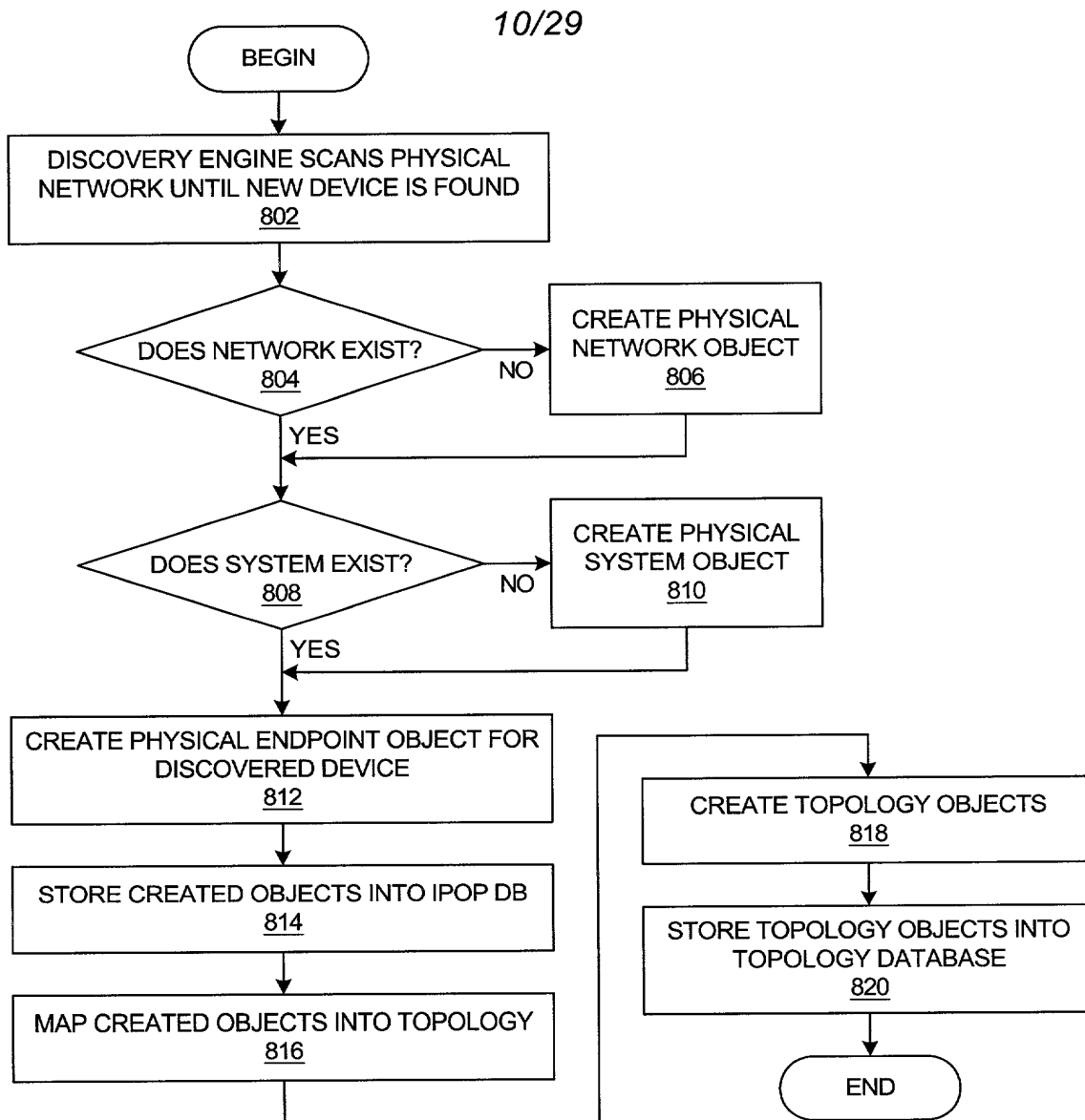configuration management within a network management framework

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```
Public Class IPActionObject {


    Endpoint sourceEP;
    Endpoint targetEP;


    // CONSTRUCTOR
    IPActionObject( Endpoint targetEP, Endpoint sourceEP ) {
        .

        .

        .

    }
    VOID performAction( ) // EXECUTES ACTION METHOD

    .

    .

    .

}
```

FIG. 11B

```
Public Class Endpoint {


    // public variables
    long    EPObjectID;  // ID to object (both private and public network addresses)
    InetAddress  EPIPAddress;       // physical network address (private or public)
    long    EPVPN;        // virtual private network ID


    //get/set of variables
    public long          getObjectID( ) { ... }
    public InetAddress  getPAddress( ) { ... }
    public long          getVPN( ) { ... }

}
```

FIG. 11C

```
Public Class EndpointCustomer extends Endpoint {

    public getVPNGW( ) {
        //gets the only gateway which has access to a particular private network

        .

        .

        .

    }
    //private variables only set/accessed by EP creator IPOP
    long    customerHashNumber;
    String  customerName;
    String  customerAnchorPath;
    Long    objectIoFPrivateGatewayRoute

}
```

FIG. 11D

Atty. Docket # AUS920010381US1
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**Method and system for presentation and specification of distributed multi-customer
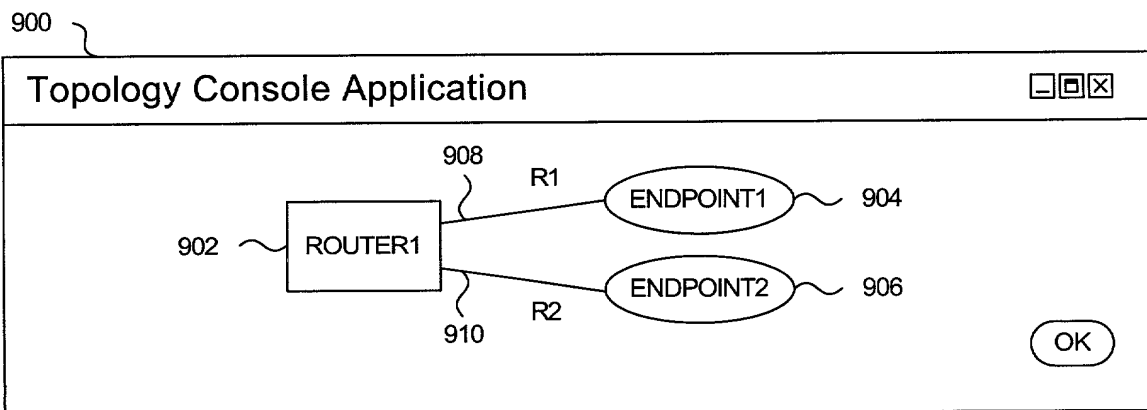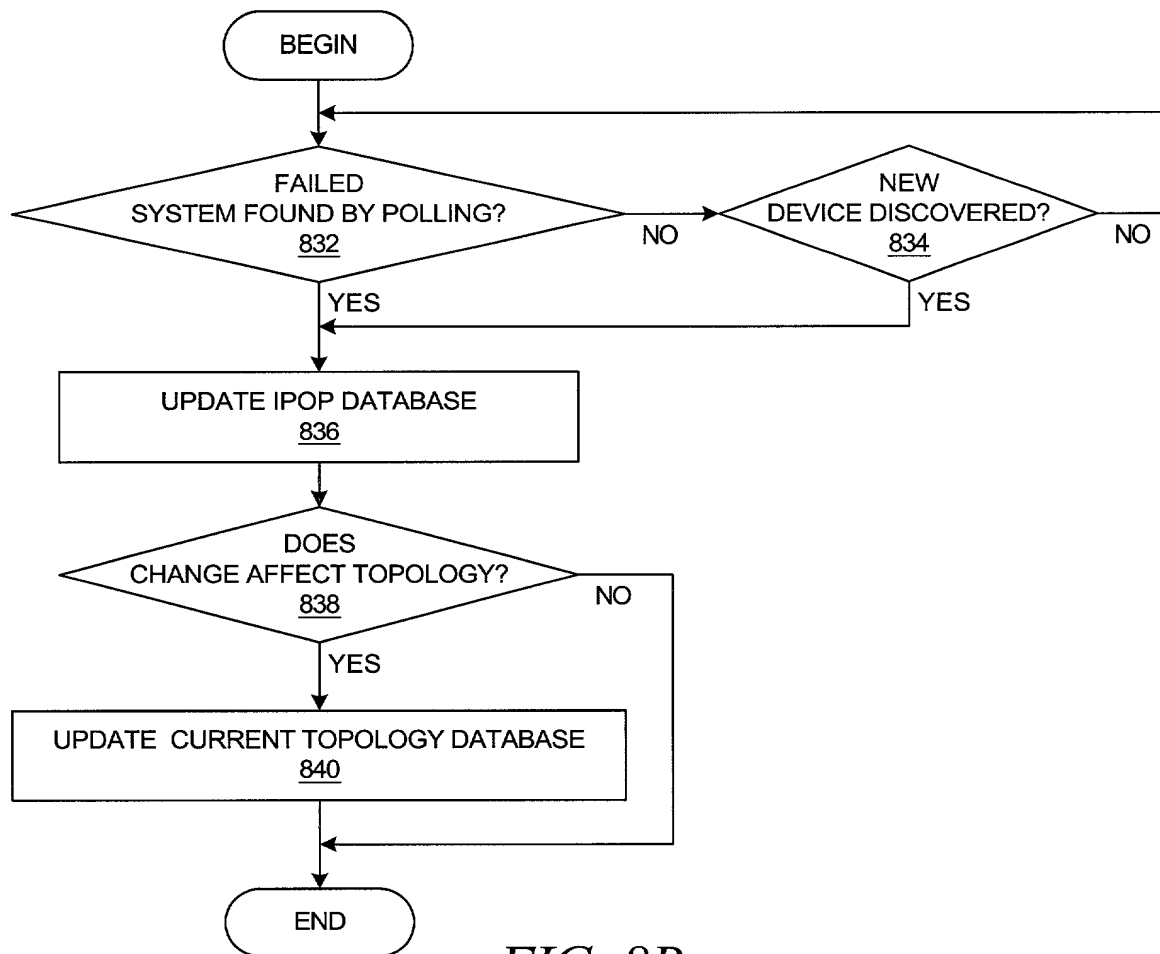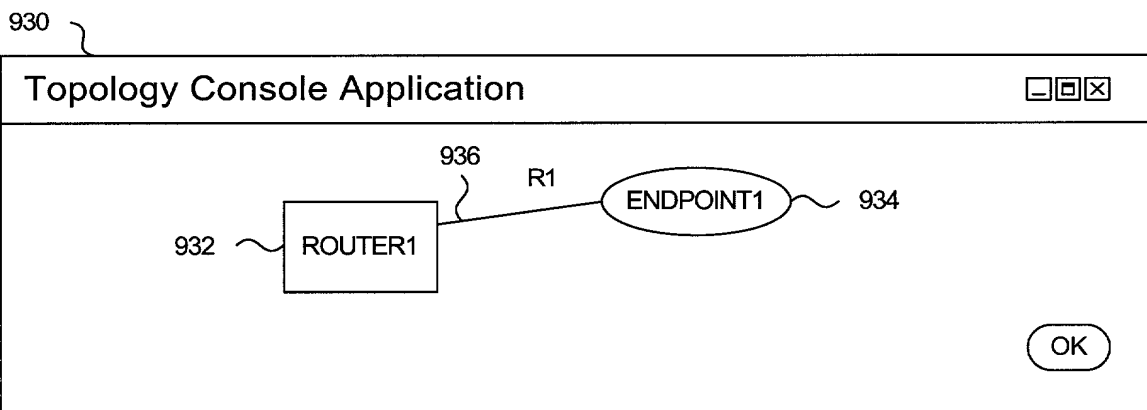configuration management within a network management framework**

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BEGIN

↓

MULTI-CUSTOMER ADMINISTRATOR
CREATES DKS VPN IDs
1202

↓

MULTI-CUSTOMER ADMINISTRATOR
CREATES NETWORK SCOPE FOR ALL
CUSTOMERS
1204

↓

ADMINISTRATOR RESOLVES
ADDRESSABILITY PROBLEMS
1206

↓

STORE MAPPING OF CUSTOMERS,
VPNs, CUSTOMER ANCHORNAMES, AND
CUSTOMER NETWORKS
IN IPOP DB
1208

↓

END

FIG. 12A

BEGIN

↓

ORB STARTS
CUSTOMER ADDRESS MANAGER
1212

↓

FIND IDENTITY OF ADMINISTRATOR
1214

↓

RETRIEVE ALL
DISCOVERED NETWORKS FOR
ADMINISTRATOR'S CUSTOMER OR
CUSTOMERS
1216

↓

ASSIGN VPN IDs TO ALL NETWORKS
NEEDING VPN
1218

↓

UPDATE NETWORK OBJECTS IN
IPOP WITH ASSIGNED VPN IDs
1220

↓

UPDATE SCOPE CONFIGURATION
WITH ASSIGNED VPN IDs
1222

↓

END

FIG. 12B

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Benfield et al.
Method and system for presentation and specification of distributed multi-customer
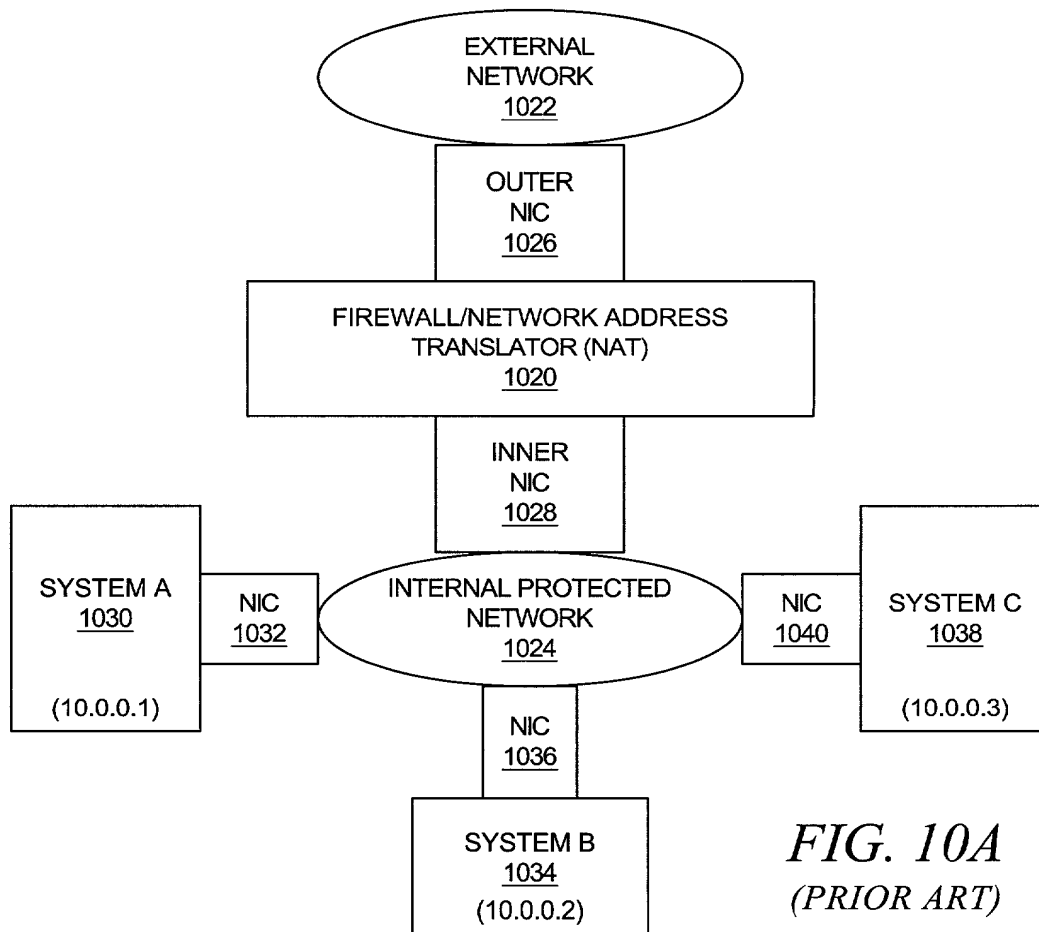configuration management within a network management framework

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BEGIN

DISPLAY NETWORKS THAT NEED A
VPN ID TO THE ADMINISTRATOR
1232

DISPLAY POSSIBLE VPN IDs FROM WHICH
ADMINISTRATOR MAY CHOOSE
1234

LET ADMINISTRATOR DEFINE VPN IDs IF
NOT ALREADY DEFINED
1236

IS
ADMINISTRATOR A
MULTI-CUSTOMER
ADMINISTRATOR?
1238

NO

YES

ASSIGN VPN ID TO NETWORKS OF
ADMINISTRATOR'S CUSTOMER
1240

GET CUSTOMER FROM
ADMINISTRATOR
1242

ASSIGN VPN ID TO THE NETWORKS
OF THE SPECIFIED CUSTOMER OF
THE ADMINISTRATOR
1244

END

FIG. 12C

Atty. Docket # AUS920010381US1
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Method and system for presentation and specification of distributed multi-customer
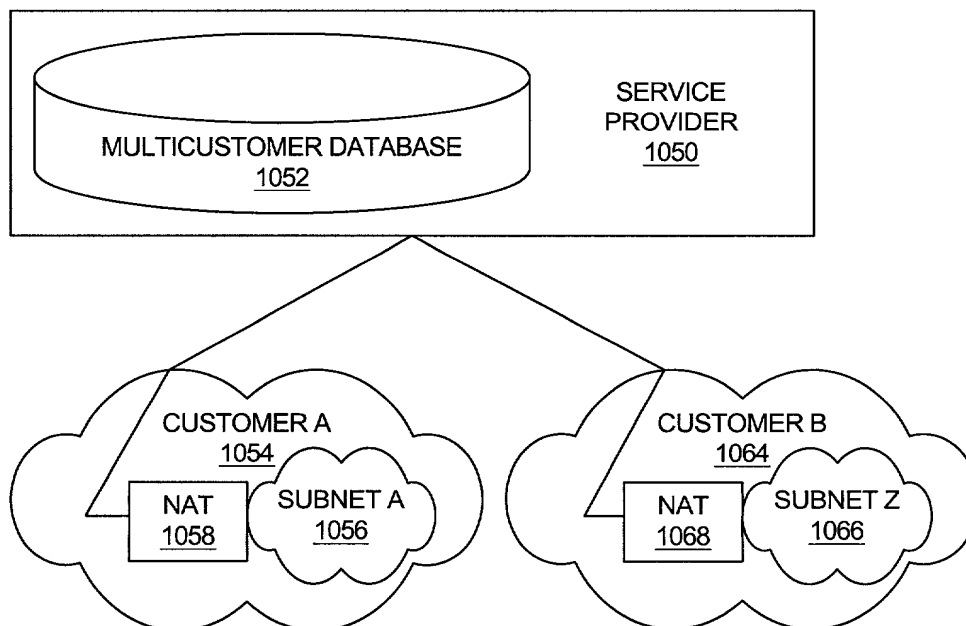configuration management within a network management framework

17/29

BEGIN

ORB STARTS PRIVATE NETWORK MULTI-CUSTOMER
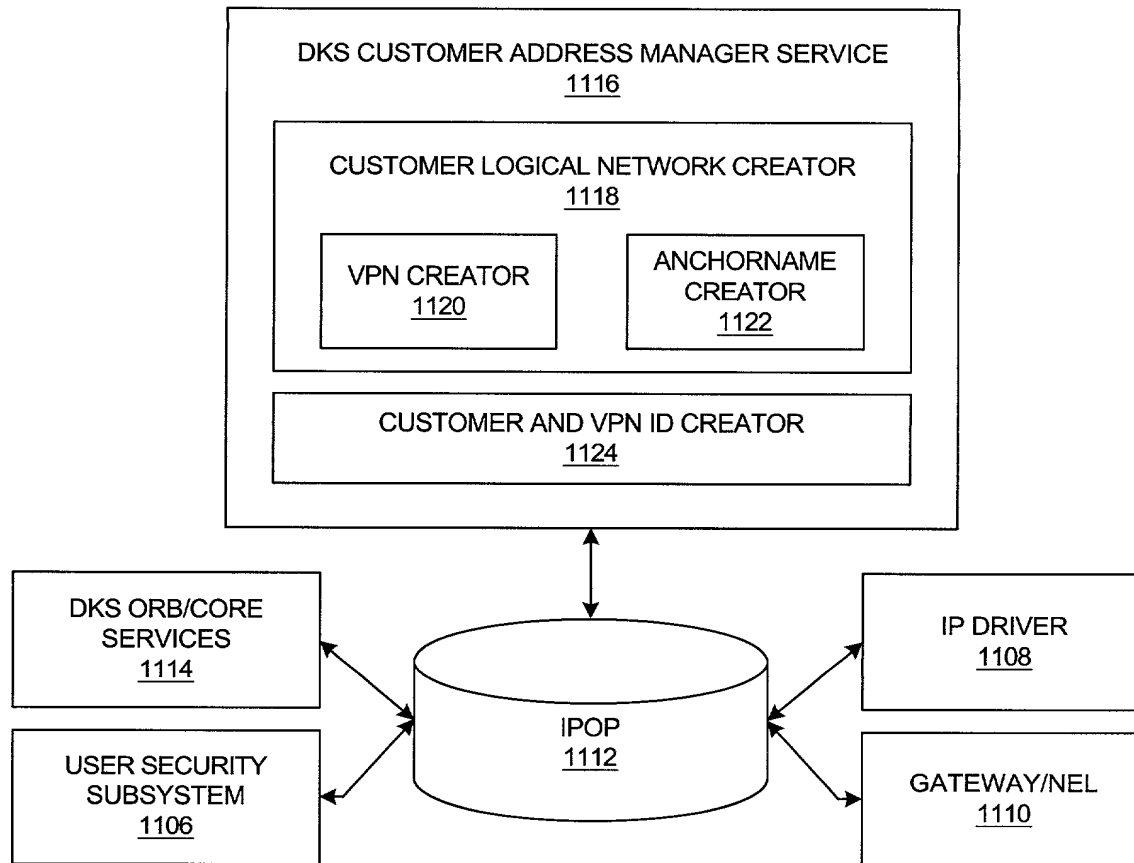MANAGER (PNMCM)
1402

ADMINISTRATOR LAUNCHES APPLICATION/GUI THAT
USES PNMCM
1404

ADMINISTRATOR CHOOSES AN ENDPOINT AND
REQUESTS TO PEFORM AN IP PING ACTION
1406

PNMCM ATTEMPTS TO FETCH REQUESTED
ENDPOINT FROM IPOP USING SPECIFIED IP
ADDRESS ONLY
1408

DOES IPOP RETURN
DUPLICATE ENDPOINTS?
1410
NO

YES

DISPLAY DUPLICATE ENDPOINTS AND ASSOCIATED
VPN ID'S
1412

REQUEST ADMINISTRATOR TO CHOOSE ONLY ONE
OF THE DUPLICATE ENDPOINTS
1414

ADMINISTRATOR REQUESTS IP PING ACTION ON
SELECTED ENDPOINT
1416

PNMCM DISPLAYS RESULTS OF PING ACTION TO
ADMINISTRATOR
1418

END

FIG. 14A

BEGIN

APPLICATION REQUESTS
APPLICATION ACTION OBJECT
OF TYPE "IP" (AAOIP) FOR
TARGET ENDPOINT FROM
GATEWAY
1422

GATEWAY ASKS NEL SERVICE
TO DECODE TARGET ENDPOINT
1424

NEL SERVICE ASKS IPOP
TO DECODE TARGET ENDPOINT
1426

IPOP DECODES ENDPOINT
ADDRESS AND RETURNS
GENERATED AAOIP INCLUDING
VPN ID TO NEL
1428

NEL SERVICE RETURNS AAOIP
TO GATEWAY
1430

GATEWAY RETURNS AAOIP
TO APPLICATION
1432

APPLICATION PERFORMS
DESIRED ACTION ("PING") ON
TARGET ENDPOINT
1434

END

FIG. 14B

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configuration management within a network management framework

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NETWORK1

ENDPOINT1 ～ 1501   1502 ～ ENDPOINT2

1508   ENDPOINT4 ～ 1504

1507 ～ SYSTEM1

1509   ENDPOINT5 ～ 1505

ENDPOINT6 ～ 1506   1503 ～ ENDPOINT3

NETWORK2

FIG. 15

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BEGIN

DETECT A CONFIGURATION CHANGE
1602

CHANGE
IN ANCHOR NAME OBJECT?
1604

YES

NO

DETERMINE WHICH IP DRIVERS ARE AFFECTED BY
DETECTED CHANGE
1612

GET ALL NETWORK-RELATED OBJECTS
ASSOCIATED WITH SCOPES OF
AFFECTED IP DRIVERS
1614

GET NEXT OBJECT
1616

DO
CUSTOMERS DIFFER WITHIN
SCOPE?
1618

YES

NO

GENERATE CUSTOMER
SECURITY BREACH EVENT
1606

MORE
OBJECTS TO BE PROCESSED?
1620

YES

NO

LOG EVENT
1608

DISPLAY EVENT TO
ADMINISTRATIVE USER
1610

END

FIG. 16

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Method and system for presentation and specification of distributed multi-customer
configuration management within a network management framework

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BEGIN

DETECT SCOPE CONFIGURATION
CHANGE OR NEW IP DRIVER
1702

DETERMINE AFFECTED IP DRIVERS
1704

GET NEXT AFFECTED IP DRIVER
1706

DETERMINE OUT-OF-SCOPE
OBJECTS IN IPOP BASED ON
NEW SCOPE
1708

GET NEXT OUT-OF-SCOPE OBJECT
1710

MARK IPOP OBJECT
AS SEED OBJECT
1712

CREATE RESPECTIVE OBJECT
IN ORPHAN TABLE
1714

MORE OBJECTS?
1716

YES

NO

SET CONFIGURATION VALUES
FOR IP DRIVER TO PERFORM
REDISCOVERY USING
IPOP SEED OBJECTS
1718

A

B

MORE
AFFECTED IP DRIVERS?
1736

YES

NO

SAVE ANCHOR NAMES FOR EACH
LOGICAL NETWORK
1738

MARK OBJECTS IN IPOP AS
CUSTOMER-DEFINED
1740

IP MAPPER CREATES CUSTOMER
CONTAINER FOR EACH CUSTOMER
1742

TOPOLOGY SERVICE DISPLAYS
CUSTOMER CONTAINERS
1744

NOTIFY USER OF COMPLETION OF
OPERATION
1746

END

FIG. 17A

Atty. Docket # AUS920010381US1
Benfield et al.
Method and system for presentation and specification of distributed multi-customer
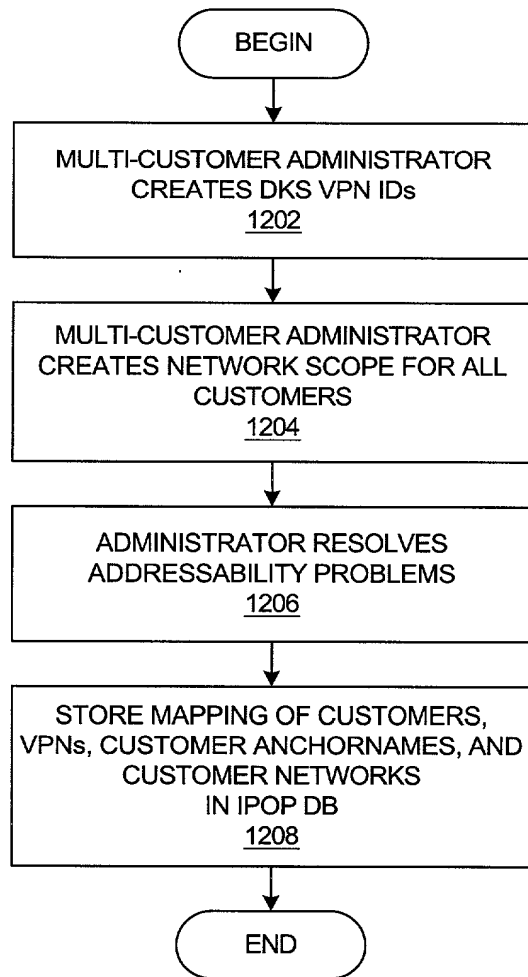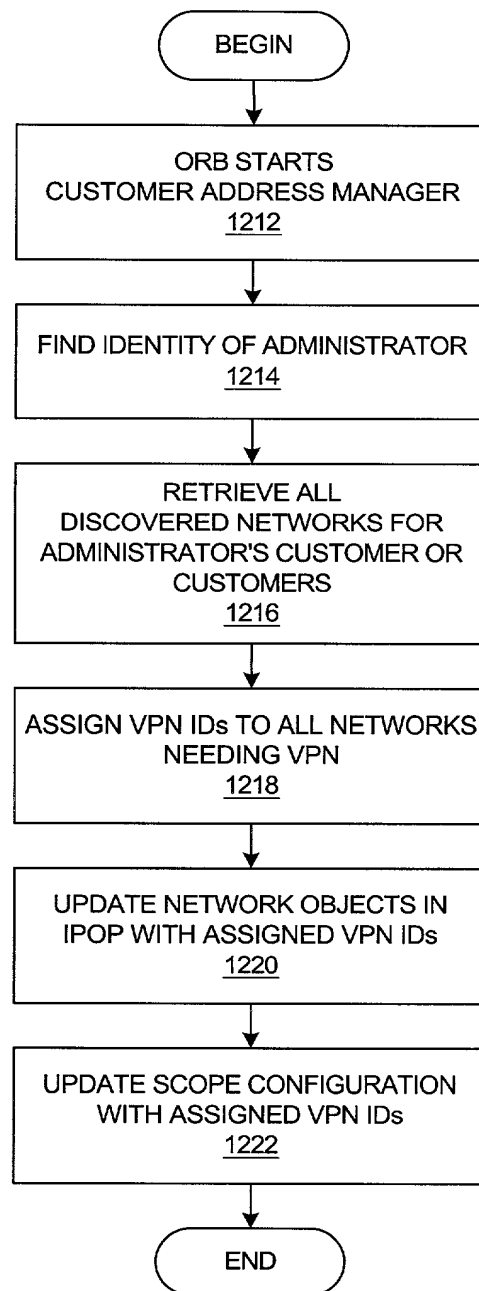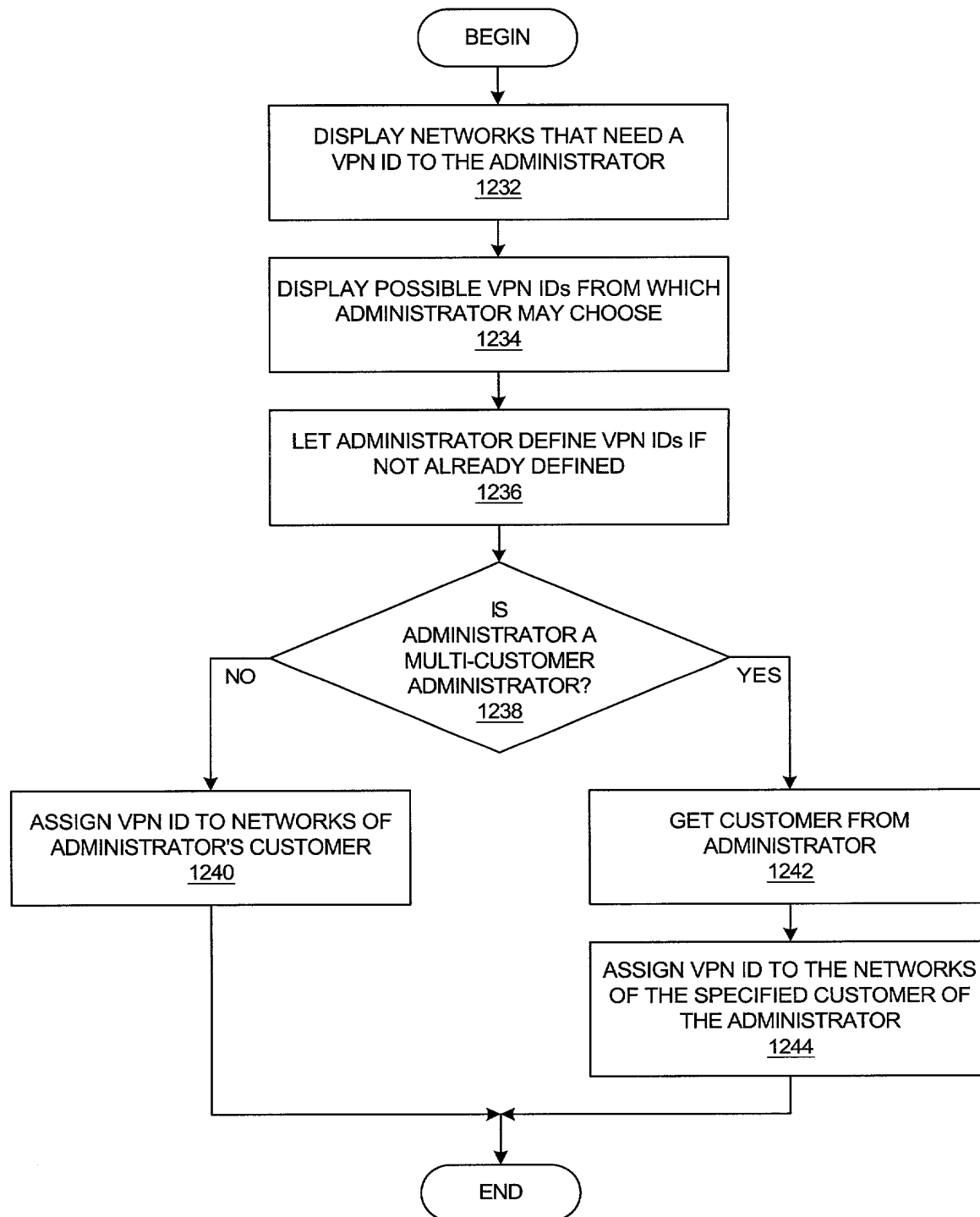configuration management within a network management framework

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```
                          ┌─────┐
                          │  A  │
                          └──┬──┘
                             │
                             ▼
                    ╱────────────────╲
                   ╱   IP DRIVER      ╲
                  ╱ ALREADY EXECUTING? ╲────────────────────────┐
                  ╲       1720         ╱        YES             │
                   ╲                  ╱                          │
                    ╲────────────────╱                          │
                             │                                  │
                            NO                                  │
                             ▼                                  ▼
              ┌──────────────────────────┐    ┌──────────────────────────┐
              │ IP DRIVER READS ALL       │    │ IP DRIVER'S CONFIGURATION │
              │ OBJECTS IN ITS SCOPE      │    │ LISTENERS DETECT CHANGE   │
              │ FROM IPOP                 │    │          1722             │
              │          1732             │    └──────────────────────────┘
              └──────────────────────────┘                    │
                             │                                 ▼
                             ▼                   ┌──────────────────────────┐
              ┌──────────────────────────┐       │ IP DRIVER FLUSHES        │
              │ IP DRIVER REGENERATES     │       │ PENDING WRITES TO IPOP   │
              │ IPOP OBJECTS              │       │          1724            │
              │          1734             │       └──────────────────────────┘
              └──────────────────────────┘                    │
                             │                                 ▼
                             │                   ┌──────────────────────────┐
                             │                   │ IP DRIVER REMOVES ALL     │
                             │                   │ OBJECTS IN ITS CACHE      │
                             │                   │          1726            │
                             │                   └──────────────────────────┘
                             │                                 │
                             │                                 ▼
                             │                   ┌──────────────────────────┐
                             │                   │ IP DRIVER READS ALL       │
                             │                   │ OBJECTS IN ITS SCOPE      │
                             │                   │ FROM IPOP                 │
                             │                   │          1728            │
                             │                   └──────────────────────────┘
                             │                                 │
                             │                                 ▼
                             │                   ┌──────────────────────────┐
                             │                   │ IP DRIVER REGENERATES     │
                             │                   │ IPOP OBJECTS              │
                             │                   │          1730            │
                             │                   └──────────────────────────┘
                             │                                 │
                             ◄─────────────────────────────────┘
                             │
                             ▼
                          ┌─────┐
                          │  B  │
                          └─────┘
```

FIG. 17B

Atty. Docket # AUS920010381US1
Benfield et al.
Method and system for presentation and specification of distributed multi-customer
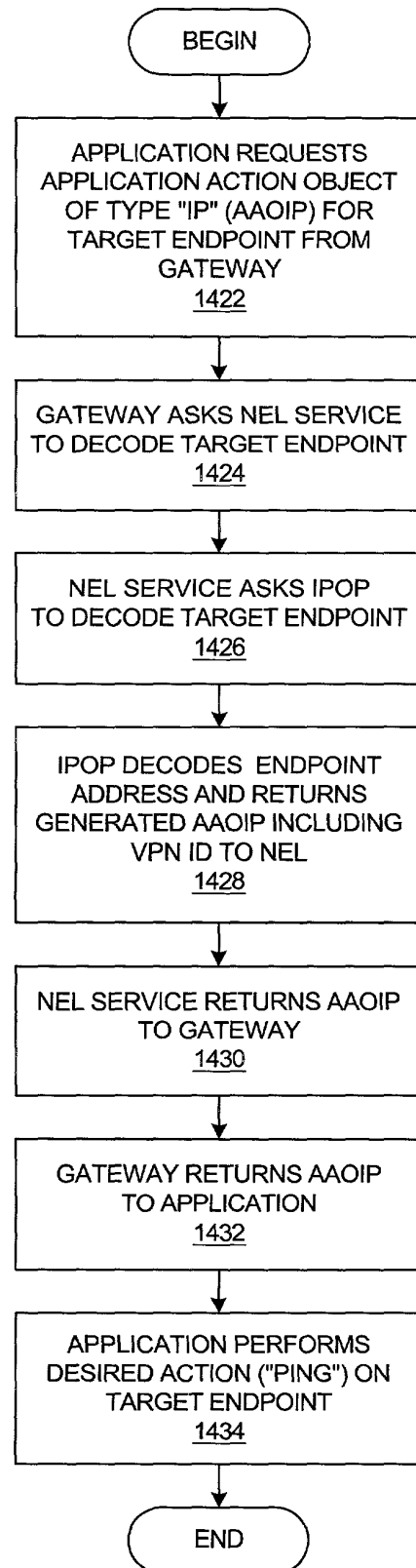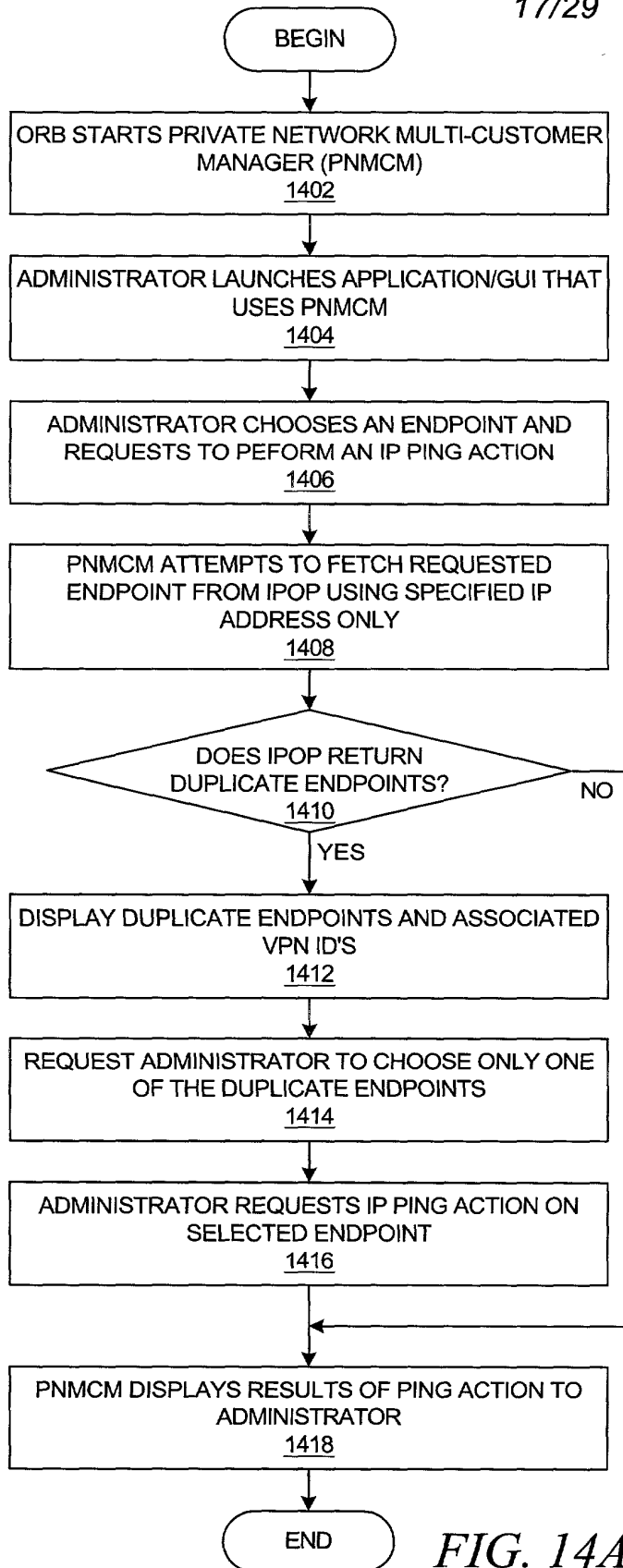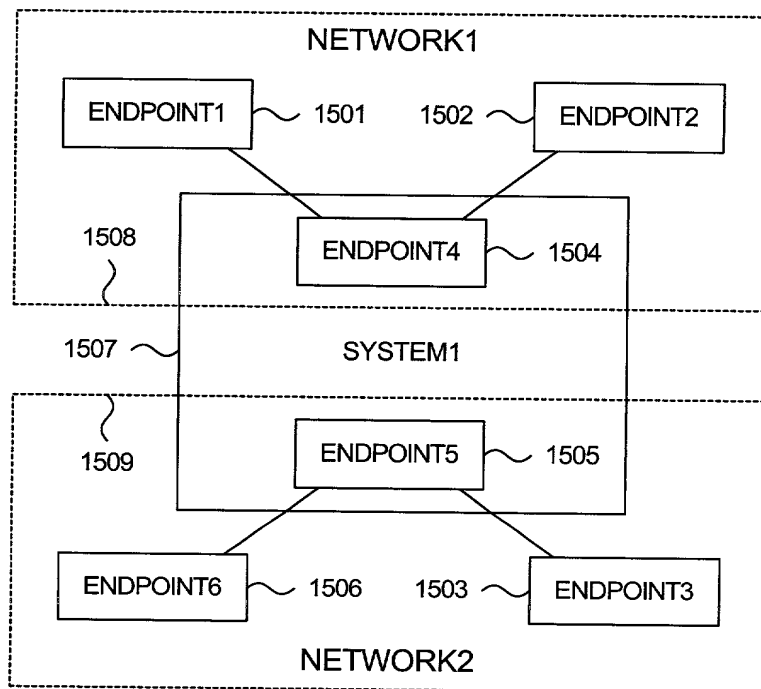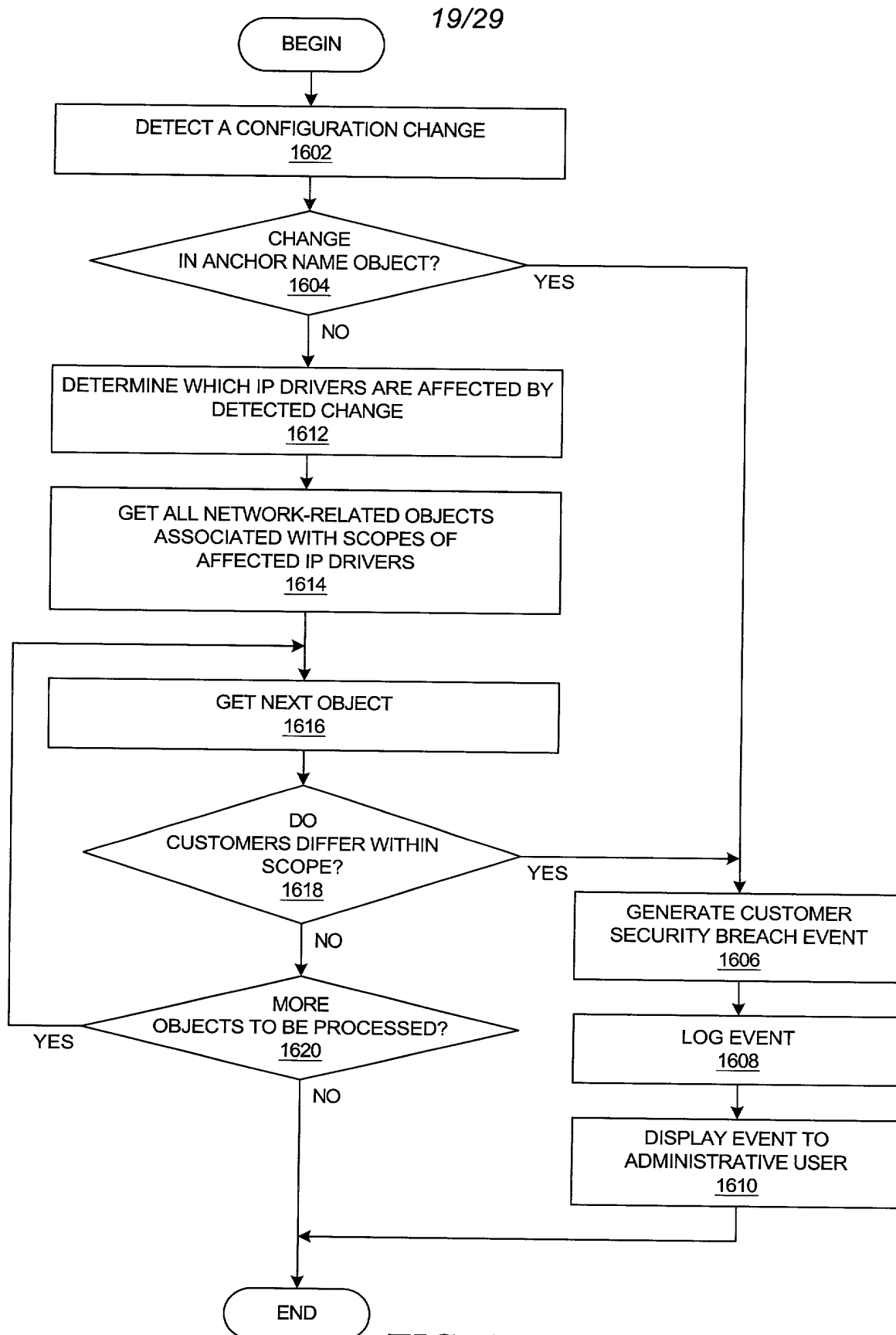configuration management within a network management framework

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FIG. 18A

FIG. 18B

Atty. Docket # AUS920010381US1
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Method and system for presentation and specification of distributed multi-customer
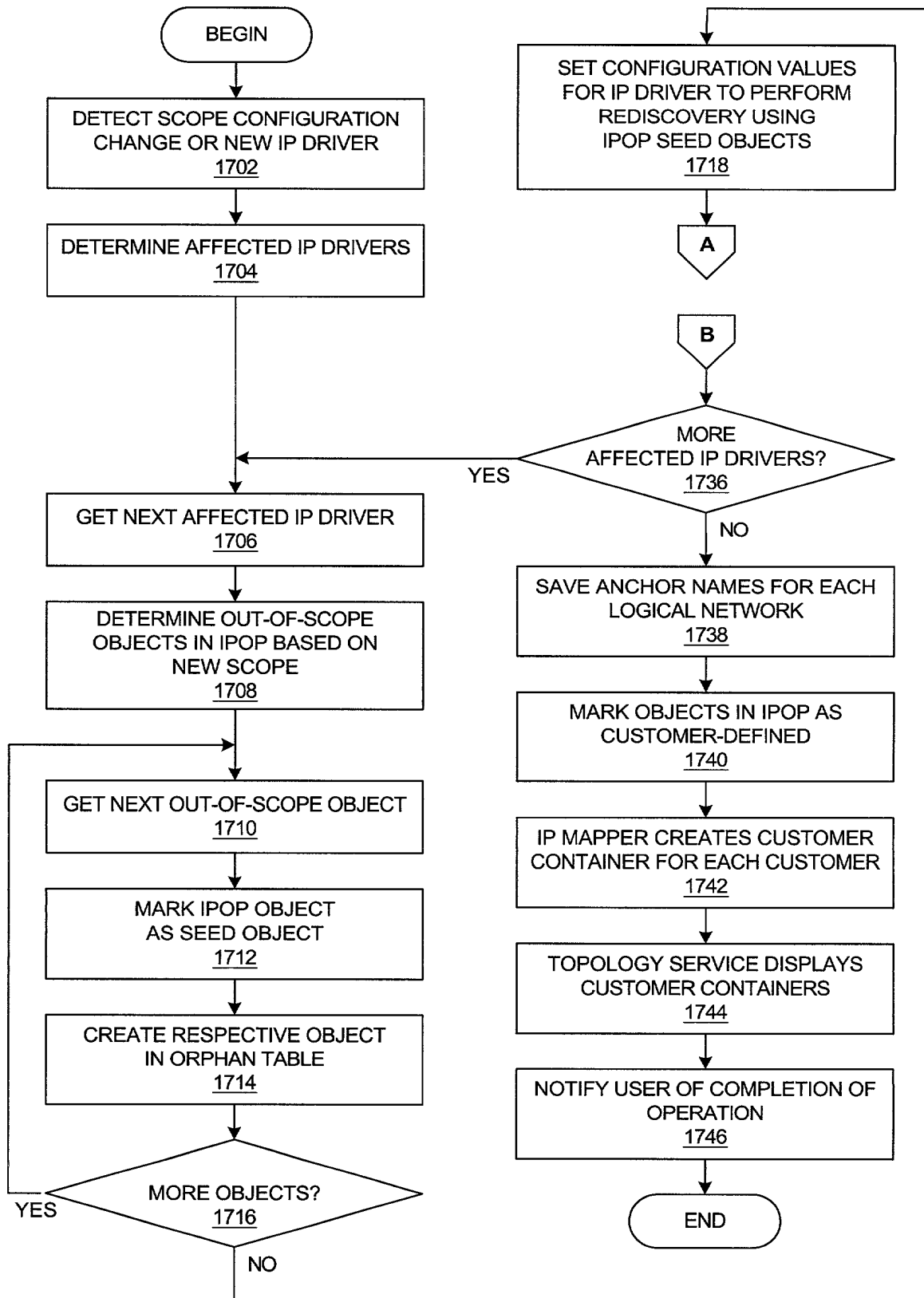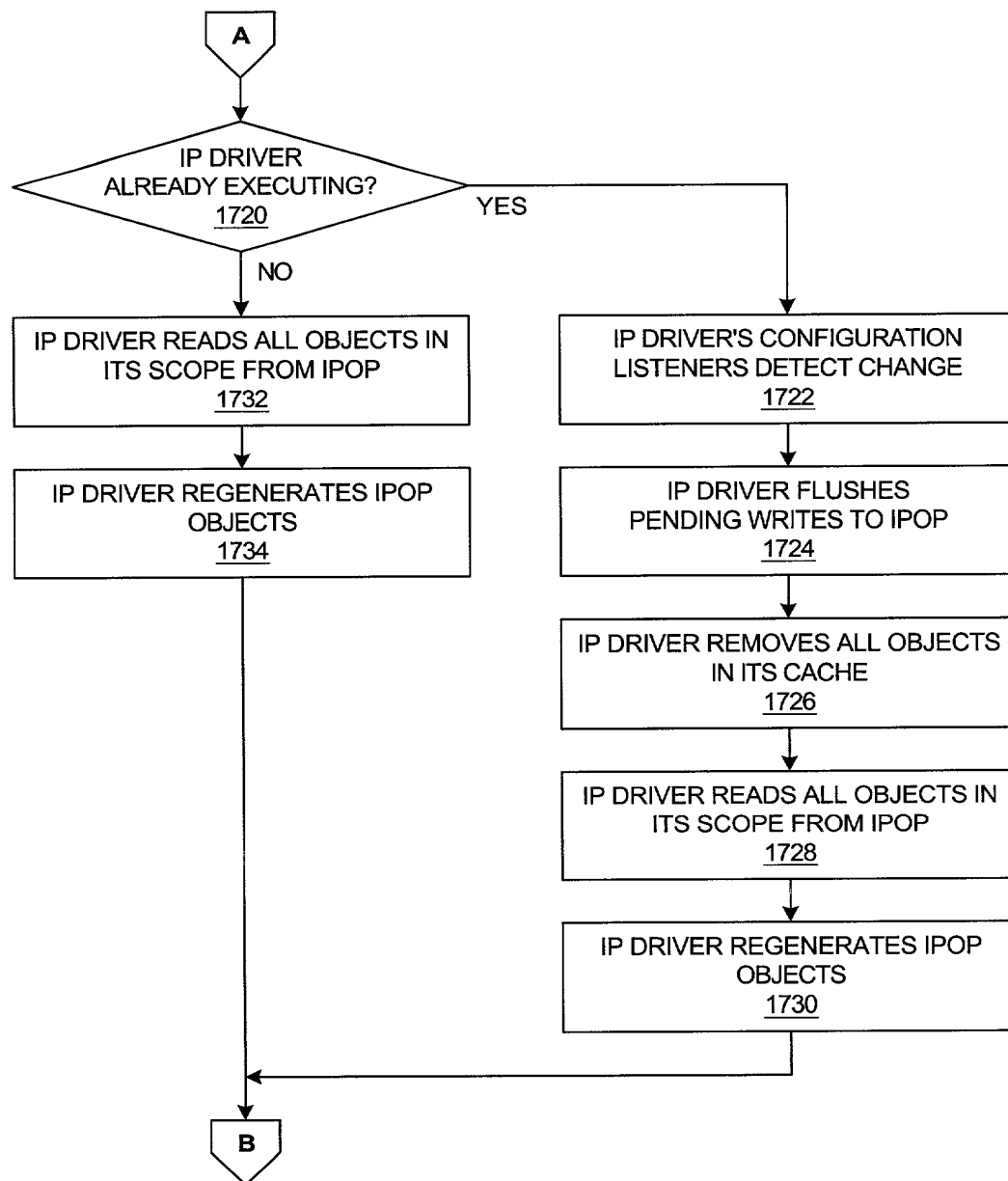configuration management within a network management framework

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```
┌─────────┐
│  BEGIN  │
└─────────┘
     │
     ▼
┌────────────────────────────────────────────────────┐
│          MULTI-CUSTOMER ADMNISTRATOR               │
│  CONFIGURES DKS COMPONENTS AT INSTALLATION TIME     │
│                      1902                           │
└────────────────────────────────────────────────────┘
     │
     ▼
┌────────────────────────────────────────────────────┐
│             START IPOP SERVICE ON ORB               │
│                      1904                           │
└────────────────────────────────────────────────────┘
     │
     ▼
┌────────────────────────────────────────────────────┐
│   START "N" NUMBER OF IP DRIVER INSTANCES ON "N" ORBs │
│                      1906                           │
└────────────────────────────────────────────────────┘
     │
     ▼
┌────────────────────────────────────────────────────┐
│  MULTI-CUSTOMER ADMINISTRATOR REVIEWS DISCOVERY AND │
│                 MONITORING STATUS                   │
│                      1908                           │
└────────────────────────────────────────────────────┘
     │
     ▼
┌────────────────────────────────────────────────────┐
│                  DETERMINE THAT                     │
│   CUSTOMER ADMINISTRATOR CONTROL CAN BEGIN          │
│                      1910                           │
└────────────────────────────────────────────────────┘
     │
     ▼
┌─────────┐
│   END   │         FIG. 19
└─────────┘
```

2000

IPOP Administration Application ⬓⬓⬓

IPOP DATABASE POOL

ALLOW TYPES OF CONNECTIONS

☒ NATIVE DATABASE DB2 — 2002

☒ NATIVE DATABASE ORACLE — 2004

☒ GENERIC DATABASE ACCESS — 2006

URL OF DATABASES: [_____] — 2012

USERID: [_____] — 2008

PASSWORD: [_____] — 2010

(CLEAR)

(SET)

IPOP TOTAL NUMBER OF ENDPOINTS DISCOVERED: 28193 — 2014

IPOP TOTAL NUMBER OF IP DRIVERS: 5 — 2016

FIG. 20

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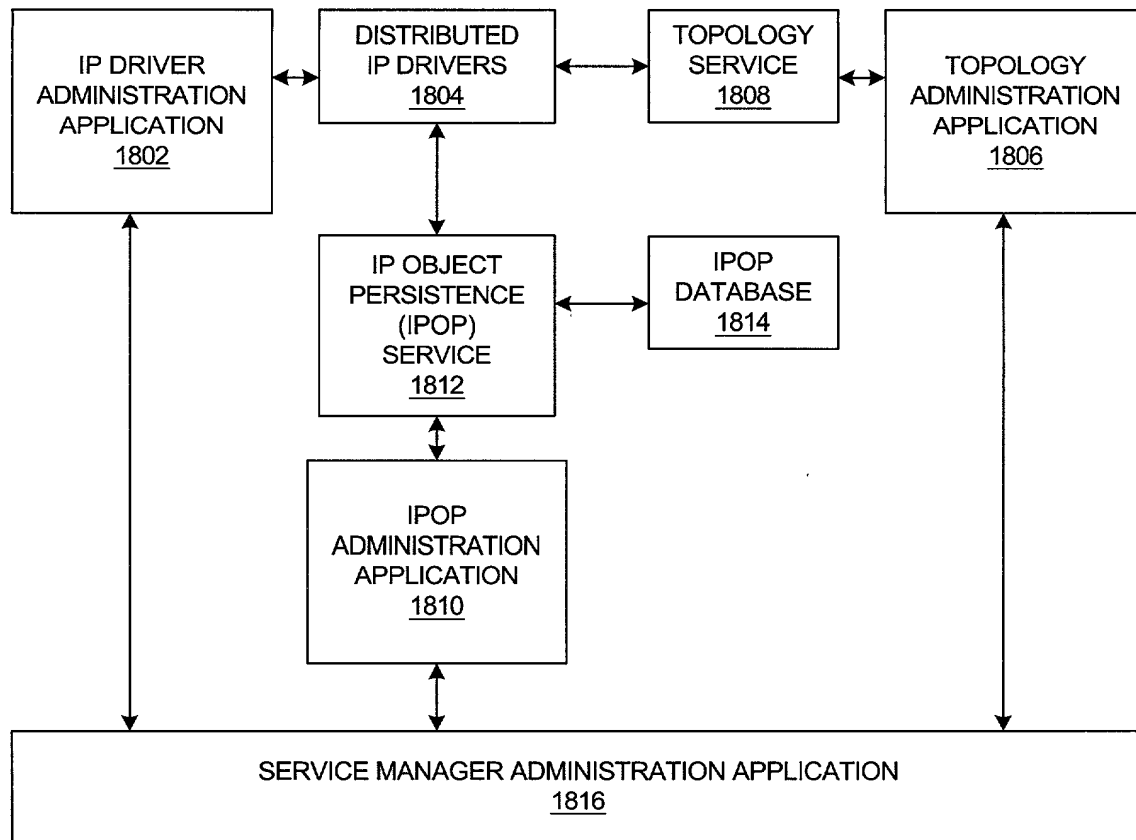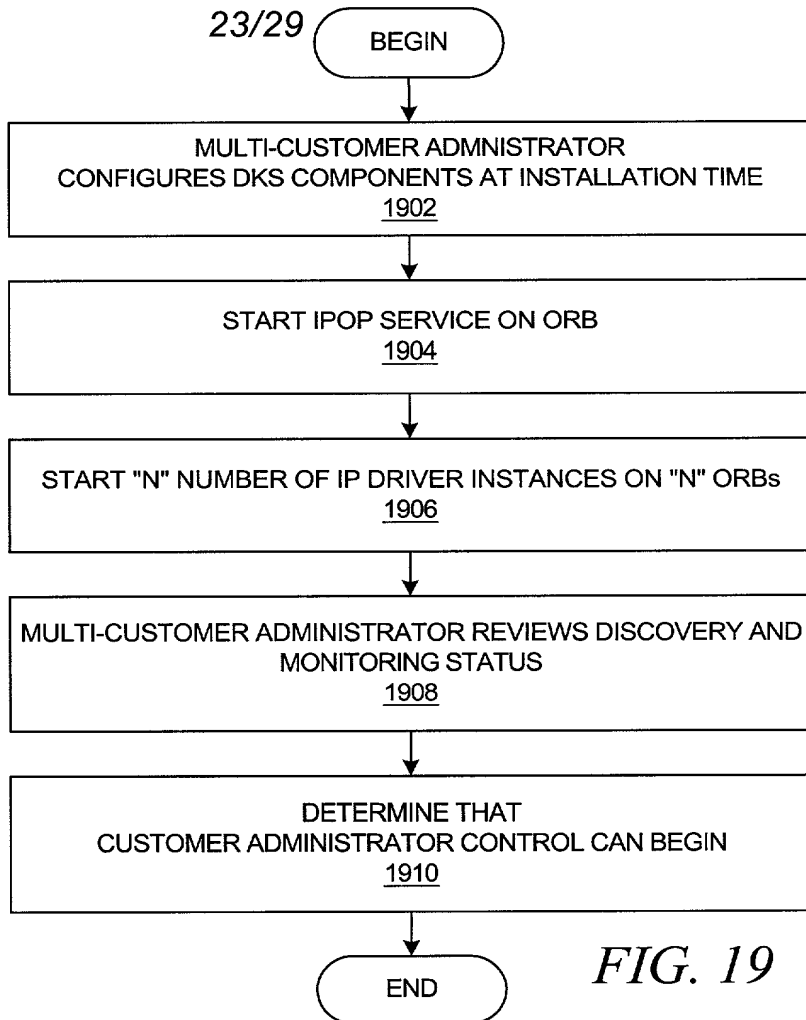configuration management within a network management framework

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```
                          ┌─────────────┐
                          │    BEGIN    │
                          └──────┬──────┘
                                 │
                                 ▼
       ┌─────────────────────────────────────────────────┐
       │  ADMINISTRATOR CREATES ADDITIONAL IP DRIVERS WITH │
       │         CORRECT CUSTOMER ANCHOR NAMES             │
       │                      2102                         │
       └─────────────────────────┬───────────────────────┘
                                 │
                                 ▼
       ┌─────────────────────────────────────────────────┐
       │  ADMINISTRATOR CREATES ADDITIONAL IP DRIVERS WITH │
       │        CORRECT GEOGRAPHIC ANCHOR NAMES            │
       │                      2104                         │
       └─────────────────────────┬───────────────────────┘
                                 │
                                 ▼
       ┌─────────────────────────────────────────────────┐
       │  ADMINISTRATOR CHECKS IP DRIVER STATUS AND IPOP   │
       │  STATUS SO THAT OTHER MANAGEMENT ACTIONS CAN BE   │
       │                   PERFORMED                       │
       │                      2106                         │
       └─────────────────────────┬───────────────────────┘
                                 │
                                 ▼
       ┌─────────────────────────────────────────────────┐
       │  ADMINISTRATOR NOTICES THAT ENDPOINT PREVIOUSLY   │
       │  FUNCTIONING IN DISCOVERY PHASE HAS FAILED        │
       │                      2108                         │
       └─────────────────────────┬───────────────────────┘
                                 │
                                 ▼
       ┌─────────────────────────────────────────────────┐
       │  ADMINISTRATOR DETERMINES OTHER DKS SERVICES TO   │
       │  START TO PERFORM DESIRED MANAGEMENT ACTIONS      │
       │                      2110                         │
       └─────────────────────────┬───────────────────────┘
                                 │
                                 ▼
       ┌─────────────────────────────────────────────────┐
       │      START NEL AND GATEWAY SERVICES ON ORB        │
       │                      2112                         │
       └─────────────────────────┬───────────────────────┘
                                 │
                                 ▼
       ┌─────────────────────────────────────────────────┐
       │         START TOPOLOGY SERVICE ON ORB             │
       │                      2114                         │
       └─────────────────────────┬───────────────────────┘
                                 │
                                 ▼
       ┌─────────────────────────────────────────────────┐
       │   ADMINISTRATOR VIEWS TOPOLOGY WITHIN TOPOLOGY    │
       │  ADMINISTRATION APPLICATION WITH RESPECT TO SUSPECT│
       │                   ENDPOINT                        │
       │                      2116                         │
       └─────────────────────────┬───────────────────────┘
                                 │
                                 ▼
                          ┌─────────────┐
                          │      C      │
                          └──────\──/───┘
```

FIG. 21A

Atty. Docket # AUS920010381US1
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Method and system for presentation and specification of distributed multi-customer
configuration management within a network management framework
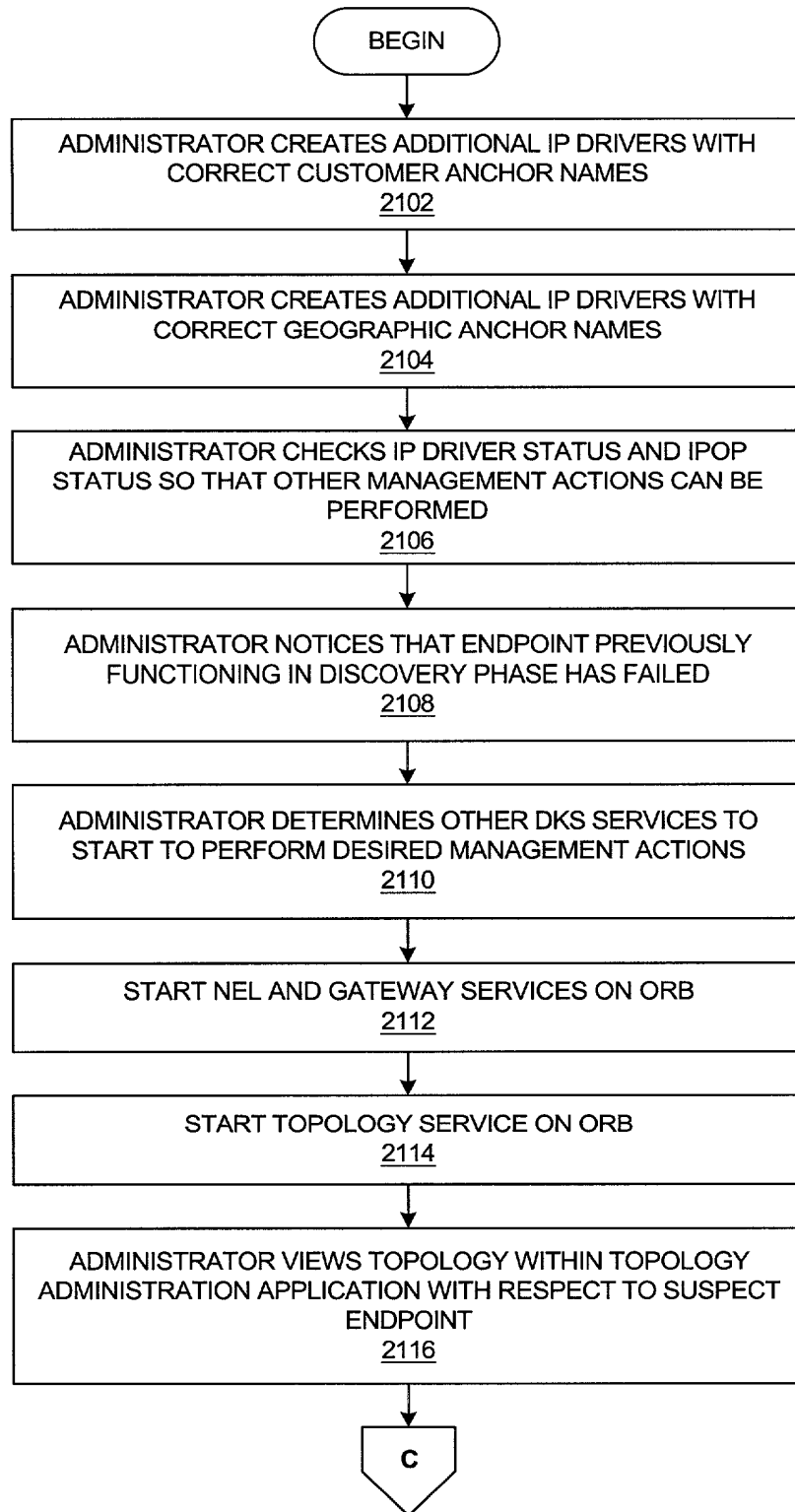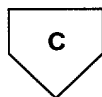
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```
                           ┌─────┐
                           │  C  │
                           └──┬──┘
                              ▼
┌─────────────────────────────────────────────────────────┐
│ ADMINISTRATOR SELECTS SUSPECT ENDPOINT IN TOPOLOGY        │
│ ADMINISTRATION APPLICATION AND REQUESTS A                 │
│ MANAGEMENT ACTION ON SUSPECT ENDPOINT                     │
│ 2118                                                      │
└─────────────────────────────────────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────┐
│ TOPOLOGY ADMINISTRATION APPLICATION ASKS IP MAPPER        │
│ TO PERFORM MANAGEMENT ACTION ON SUSPECT ENDPOINT          │
│ 2120                                                      │
└─────────────────────────────────────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────┐
│ IP MAPPER REQUESTS AAO FOR REQUESTED MANAGEMENT           │
│ ACTION FROM NEL/GATEWAY SERVICES                          │
│ 2122                                                      │
└─────────────────────────────────────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────┐
│ NEL GETS ROUTING INFORMATION                              │
│ 2124                                                      │
└─────────────────────────────────────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────┐
│ NEL/GATEWAY SERVICES RETURN AAO TO IP MAPPER              │
│ 2126                                                      │
└─────────────────────────────────────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────┐
│ IP MAPPER USES AAO TO PERFORM MANAGEMENT ACTION           │
│ AND RETURN STATUS BACK TO TOPOLOGY ADMINISTRATION         │
│ APPLICATION                                               │
│ 2128                                                      │
└─────────────────────────────────────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────┐
│ TOPOLOGY ADMINISTRATION APPLICATION DISPLAYS RESULTS      │
│ OF REQUESTED MANAGEMENT ACTION TO ADMINISTRATOR           │
│ 2130                                                      │
└─────────────────────────────────────────────────────────┘
                              ▼
                         ┌─────────┐
                         │   END   │
                         └─────────┘
```

FIG. 21B

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Method and system for presentation and specification of distributed multi-customer
configuration management within a network management framework

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THREAD CONFIGURATION POLICY

ENTER # THREADS PER IP DRIVER
DISCOVERY CONTROLLER: [   ]

ENTER # THREADS PER IP DRIVER
MONITOR CONTROLLER: [   ]

ADAPT # THREADS BASED ON LIFE
CYCLE OF DISCOVERY ENGINE: [   ]

General Properties Configuration Panel

General

Monitor ID   7

Number Of Polling Threads   24

OK   Apply   Undo   Cancel

FIG. 22

← 2200

Scope Property Configuration Panel

FIG. 23

← 2300

Monitor Scope

Subnet   Mask   Priority   CustomerID   Private Network ID
146.84.28.0   255.255.255.0   0
89.0.0.0   255 0 0.0   0

OK   Apply   Undo   Cancel

Discovery Mechanisms Configuration Panel

FIG. 24

← 2400

Discovery Mechanisms

X Enable ping spread discovery.
    Poll the routing table of network systems.
X Poll the ARP table of network systems.
    Enable unsolicited ping discovery.

Start discovery using these network addresses:
___.___.___.___   Add/Delete

146.84.28.107

OK   Apply   Undo   Cancel

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Method and system for presentation and specification of distributed multi-customer
configuration management within a network management framework

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. ARP Table Discovery Configuration Panel

FIG. 25

ARP Table Discovery

Interval to poll ARP tables: 10h

Maximum number of ARP table entries to poll: 100

OK   Apply   Undo   Cancel

← 2500

ıuting Table Discovery Configuration Panel

FIG. 26

Routing Table Discovery

Interval to poll routing tables: 10h

Maximum number of routing table entries to poll. 100

X Discover unnumbered IP interfaces in routing tables.

OK   Apply   Undo   Cancel

← 2600

Ping Spread Discovery Configuration Panel

FIG. 27

Ping Spread Discovery

Interval to initiate ping spread operations: 10h

Ping Spread Mask: 255.255.255.0

Interval between pings in milliseconds: 50ms

OK   Apply   Undo   Cancel

← 2700

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configuration management within a network management framework

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FIG. 28

. Node Configuration Panel

← __2800__

Node Information

X Use SNMP to poll system status.

Poll systems without SNMP agents

Delete nodes that have responded after 3d.

OK   Apply   Undo   Cancel

. DHCP Node Configuration Panel

FIG. 29

DHCP Node Information

DHCP Address Ranges:

___ ___ ___.___ Add/Delete

123.123.123.1-254

Delete DHCP nodes that have responded after 1d

OK   Apply   Undo   Cancel

← __2900__

FIG. 30

. Configuration Status Panel

← __3000__

Configuration Status,   IP DRIVER 7

Monitor ID 7
Number of Polling Threads   24
Discovery Mechanisms
    ARP Table Discovery
        10h poll interval
        100 max entries
    Routing Table Discovery
        24h poll interval
        1000 max entries
Node Delete Interval   3d
DHCP Addresses 123.123.123 1-254

DHCP Node Delete Interval· 1d

OK   Apply   Undo   Cancel

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FIG. 31

Thread Status Panel

Thread Status, **IP DRIVER 7**

← 3100

Thread	Status	Task
265	idle	
266	running	ARP table poll - 123.123.67.3
267	idle	

.

OK   Apply   Undo   Cancel

FIG. 32

Task Status Panel

Task Status, **IP DRIVER 7**

← 3200

Task	Status	Thread
ARP table poll - 146 84 28 107	scheduled	unassigned
ARP table poll - 123 123.67.3	running	319

.
.

OK   Apply   Undo   Cancel

FIG. 33

Navigation Panel

← 3300

```
— General
— Scope
— Discovery
    —ARP Table
    —Routing Table
    └Ping Spread
— Nodes
— DHCP Nodes
└ Status
    —Configuration
    —Threads
    └Tasks
```